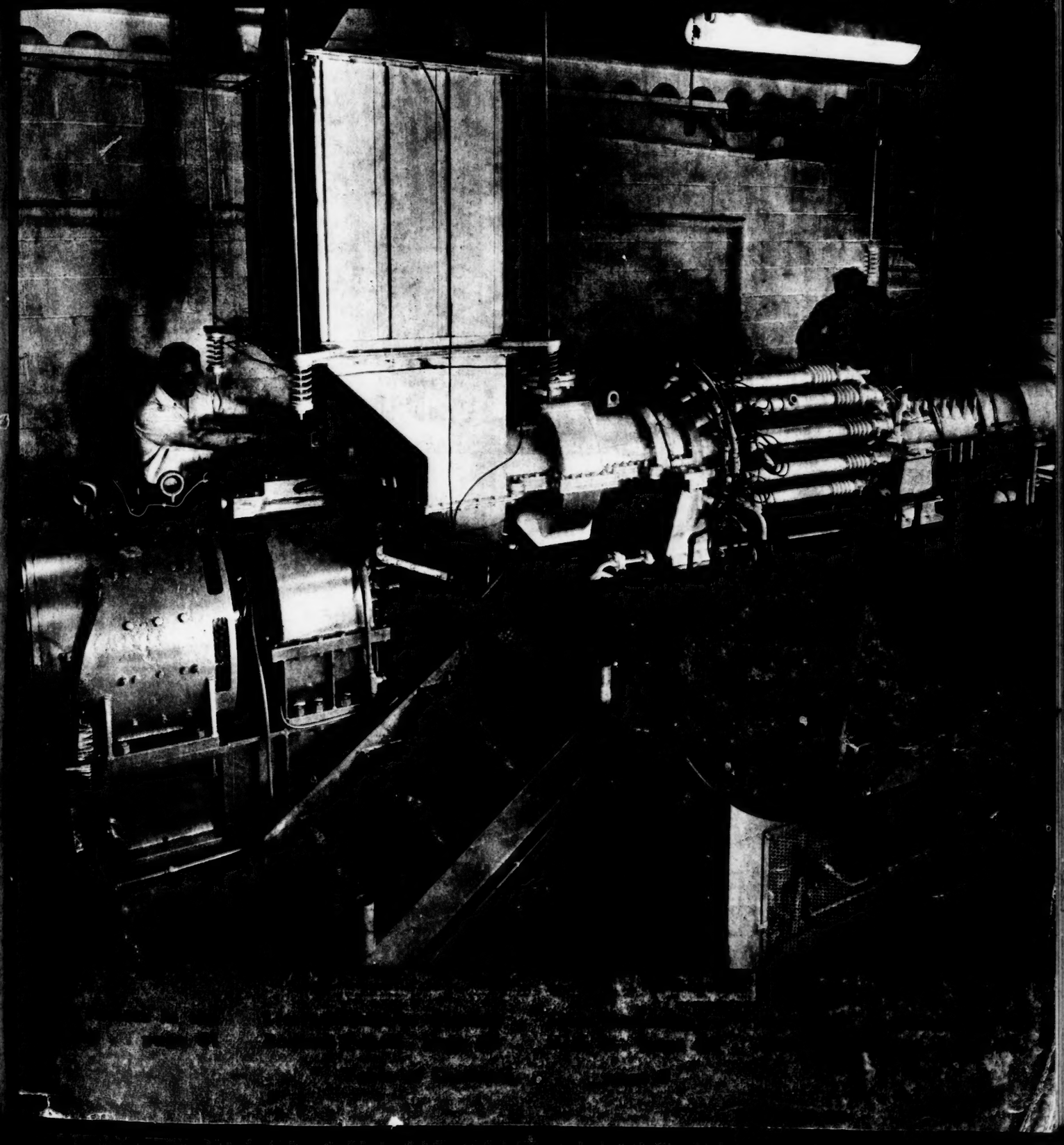
HEATING AND VENTILATING



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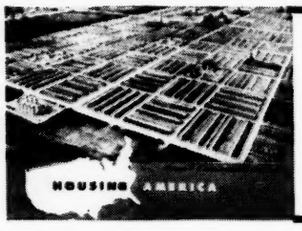

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HEATING AND VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH THE DESIGN AND APPLICATION OF AIR CONDITIONING, REFRIGERATION, PIPING, AIR SANITATION, HEATING AND VENTILATION IN BUILDINGS

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Associate Editors
NATHAN N. WOLPERT
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Advertising Staff

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GEORGE G. TURNER
228 North La Salle Street
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Eastern Representative
HARRY J. TWINE
148 Lafayette Street
New York 13, N. Y.

Pacific Coast Representative
ROBERT H. DEIBLER
2506 W. 8th Street
Los Angeles 5, Calif.

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President
ROBERT B. LUCHARS

Vice-President and Treasurer
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Secretary and Publishing Manager
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PUBLISHERS OF MACHINERY & MACHINERY'S HANDBOOK
The INDUSTRIAL PRESS

THIS MONTH'S COVER

The same 2000-hp gas turbine that recently completed more than a thousand hours of test operation at the Westinghouse Turbine Division is about to be shipped to the Mississippi River Fuel Corp. where it will go into service driving a centrifugal compressor at 8750 rpm on the natural gas line between Monroe, La., and St. Louis, Mo.

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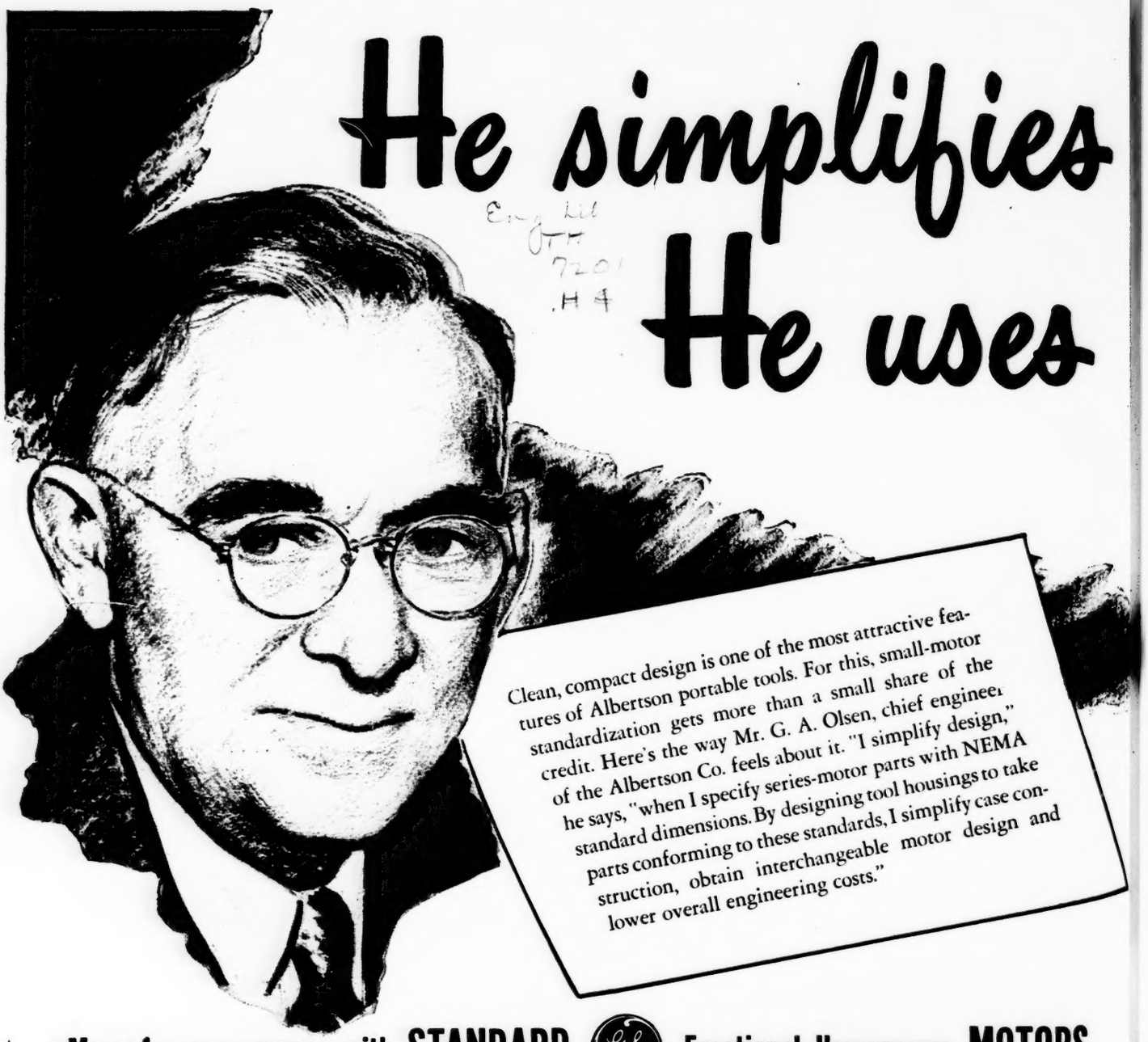


Clean, compact design is one of the most attractive features of Albertson portable tools. For this, small-motor standardization gets more than a small share of the credit. Here's the way Mr. G. A. Olsen, chief engineer of the Albertson Co. feels about it. "I simplify design," he says, "when I specify series-motor parts with NEMA standard dimensions. By designing tool housings to take parts conforming to these standards, I simplify case construction, obtain interchangeable motor design and lower overall engineering costs."

More for your money with STANDARD Fractional-Horsepower MOTORS

GENERAL ELECTRIC is now producing *definite-purpose* motors, such as washing-machine motors, sump-pump motors, hermetics and the others shown below, as well as 11 types of general-purpose motors. These are being made in *standard designs*. Ratings, performance standards, dimensions, and special features (such as type of enclosure, bearings, etc.) follow the standards worked out by the National Electrical Manufacturers Association in conjunction with your industry associations. Thus, you get all the advantages of standardization and—over 1600 G-E standard motors to choose from.

A Recent Bulletin You'll Want. A brief, but concise G-E bulletin tells what the standards are and how they are applied. Ask your local G-E office for Bulletin GES-3565 or write *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

Lower Prices are Proof. Increased production costs made it necessary for General Electric to adjust its prices upwards in June of 1948. However, prices on fractional horsepower motors are still 5% lower than they were in December, 1947 due to two successive price reductions in 1948 both of which were direct results of the standardization program. With fewer motor types to build, G.E. has been able to concentrate on those motors most widely demanded. The resulting savings are passed along to you and your customers as worthwhile price reductions.

Unit-Bearing Fan

Washing Machine

Oil Burner

Machine Tool

Gas Pump

Hermetic Refrigeration

Washington News

LORING F. OVERMAN

ONE of the more timely December news cartoons in Washington papers pictured Santa Claus Truman, his pack heavily laden with campaign promises, wondering just how he could descend from a snow-covered roof top through a rather small chimney labeled, "The 81st Congress."

Washingtonians smiled over the cartoon. But they didn't laugh derisively. Knowing from recent experience that Harry Truman is fully as elusive as St. Nicholas himself, better judgement dictated taking a wait-and-see attitude. "He did the impossible once," they observed.

In any event, Washington's year ended with all agreed that the President approaches his new term with plenty of promises made, with a lot of personal prestige to back up his demands, and with a Congress that it firmly controlled by the President's party. It is probable that if the legislative ball could start rolling immediately following delivery of the President's State-of-the-Union and Budget messages on January 5, the Congress would probably grind out just about anything really demanded by the President.

Organization First

But things in Washington seldom function quite that rapidly. First there must be a complete reorganization of Congress itself. Committees, heavily staffed with Republican Senators and Congressmen in the 80th Congress, must be completely revamped. Then must come new public hearings on all important legislative proposals. That such hearings will merely repeat much of the testimony given before committees of the 80th Congress is of no importance. Legislation to be introduced to the 81st Congress must be considered new legislation, to start from scratch and proceed all the day to the usually drawn-out conclusion.

In the interim, it is not unlikely that some Senators or Congressmen who would vote yes if certain questions were asked tomorrow, might vote no three months from now. By that time it will be more apparent whether the President is insistent upon passage of a measure, or whether he was merely speaking for the record. It will be known whether the election upset was really a voters' mandate, or whether the President's electioneering style merely caught the public fancy. More important, it will be known by members of Congress how much they must temper their own views on certain subjects if they are to win support of fellow legislators when their own pet projects come up for consideration.

It may be assumed, however, that the 81st Congress will not be a hold-back Congress. It has the majorities to put things over when its members are sure they are all headed in the same direction. At the same time, its majorities are not so overwhelming that runaways are likely, or that there will not be disagreements between the majority party itself, particularly when certain Civil Rights questions arise.

The main difference between the problem of the coming Administration and that of some in the past it that President Truman, instead of regarding campaign promises as merely oratory, appears to be taking them very seriously.

Taft-Hartley Act

High on the list is the President's promise to labor —a promise of outright repeal of the Taft-Hartley labor law. As the year ended, Administration officials were drafting possible approaches. Few agree that the law has turned out to be the slave-labor law which unions called it, but it appears inevitable that three or four of the most controversial sections will be repealed, and that the old Wagner Act will be revived and amended. Almost certain to be wiped out is the ban on the closed shop, and the provision that a majority of employees must agree before a union shop can be installed in a plant. In addition, the Administration may recommend modification of provisions relating to jurisdictional strikes, national emergency disputes, anti-communist affidavits, injunctions, and the Federal Mediation and Conciliation Service.

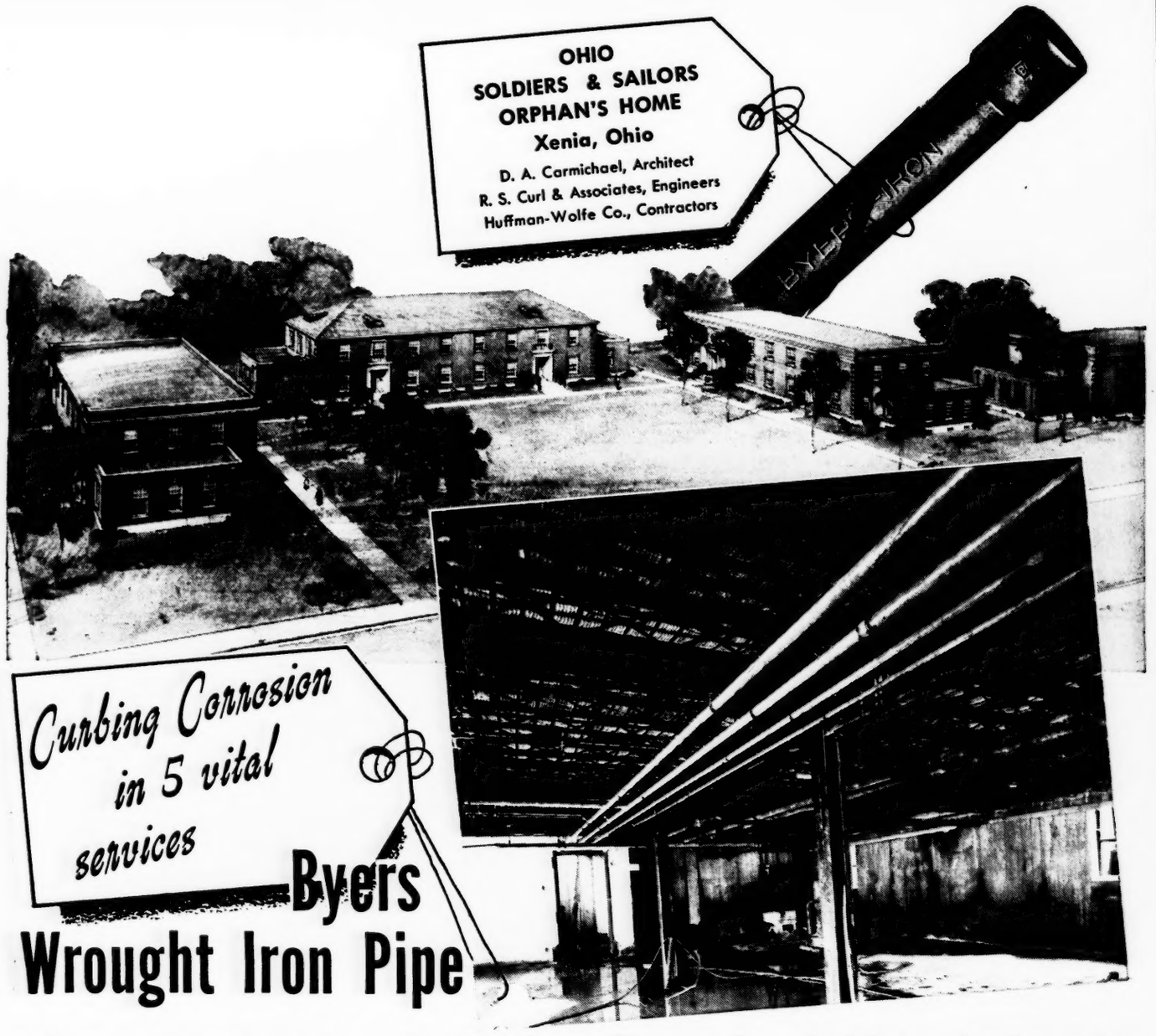
Labor and Public Works

Senator Elbert D. Thomas (D-Utah), slated to become chairman of the Senate Labor and Public Works Committee, has indicated he will work for a new law that will incorporate the best of both the Wagner and Taft-Hartley Acts. Other projects high on the docket of Senator Thomas' committee are Federal Aid to Education, a Science Foundation Bill, and revision of the Wage-Hour Act. While some revision of the Taft-Hartley Act appears certain, it is interesting to note that the new Congres will include 50 Senators and 223 Congressmen who voted to override the President's veto when the original act was passed. Constituting a majority in both houses, this group could serve as an effective brake in preventing a complete runaway when labor legislation is considered.

Wage-Hour Changes

Probably because Wage-Hour changes can probably be made without too much controversy, two possible revisions in this legislation are likely to precede action on the Taft-Hartley law. One change would raise the statutory minimum wage from the present 40 cents per hour to at least 75 cents.

The second "must" change in Wage-Hour law requires clarification of overtime-on-overtime provisions. A Surpreme Court ruling on present overtime provisions of the law makes employers liable for many millions of dollars in back overtime payments which, all agree, was not intended in drafting the legislation. The total liability would be materially raised if the minimum wage figure were placed at either 75 cents or $1.00.



Curbing Corrosion in 5 vital services

Byers Wrought Iron Pipe

In this group of ten cottages and a recreational building, the designers recognized the importance of building for *durability,* as a hedge against high maintenance costs. The hot water lines, the cold water lines, the vents and drainage lines under 2-inches, and the condensate returns in the heating tunnel were all specified "wrought iron". Byers Wrought Iron pipe was installed. Of equal importance—*wrought iron nipples* were used in all these lines, so no "weak links" would be present.

SUPPORTED BY EXPERIENCE

The selection of wrought iron pipe for these services follows sound and established engineering practice, and is supported by service records. Surveys made in a number of areas have shown wrought iron pipe in plumbing and heating services still serving after 30, 40, and even 50 years. In many instances, the wrought iron pipe had replaced pipe made of ordinary material, which had failed in a fraction of that time.

WHY WROUGHT IRON LASTS

Wrought iron's unusual service qualities come from its unusual two-component character, which is duplicated in no other material. Tiny threads of glass-like silicate slag, distributed through the body of high-purity iron, halt and "detour" corrosive attack. The fibers also help to anchor the initial protective scale, which shields the underlying metal.

Our bulletin, "Wrought Iron for Piping Services" reviews the corrosive conditions encountered in various applications, and reports engineering experience with wrought iron. Ask for a copy.

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CORROSION COSTS YOU MORE THAN WROUGHT IRON

Housing Legislation

During his campaign, President Truman was optimistic over what could be accomplished for veterans and others through subsidies for slum clearance and public housing, as well as other expansion of Housing and Home Financing Agency procedures. An early legislative effort to translate his conviction into authorization is likely. It is known, however, that there are many in Congress who feel that merely making additional funds available on easier terms will not produce housing as long as costs remain high, and demand keeps the construction labor force fully employed.

As during the campaign, the real estate lobby will probably be the target of name-calling before housing legislation of the type the President envisions is enacted.

Educational Aid

Also promised by the President and the Democratic platform is federal aid to education, administered by and under the control of the States. The platform urges a $300,000,000 appropriation as "a beginning of federal aid." Such a bill was passed by the Senate during the 80th Congress, but in that instance the House Labor Committee bottled up the legislation. Unless Congress gets word from the folks back home that federal aid may not be worth the price to be paid in federal controls, this legislation could skim through with little difficulty. The federal aid to schools program is indeed another of those projects which poses the question: "Just how far should the federal government go, and where should its activities cease?" There are those who believe that every time an individual or a State accepts largesse from the common pool, he must in turn give up some additional independence. They believe, too, that while the first steps usually have a commendable objective in view, getting a foot inside the door often paves the way for something more.

Apparently, however, those who think along such lines are not sufficiently numerous to elect presidents. So the new Administration takes office convinced that the majority want as much as possible from "the guv-ment." Yes, the Federal Aid to Education Bill may pass. In its early stages, at least, it should be a boon to the heating, ventilating and air conditioning industries. There'll be a lot of nice new school buildings erected, and no one can deny that they are sorely needed.

Social Security

The vote-expressed wish of the people for more cradle-to-grave provision is also being heeded by the Administration. It is only because of lack of time that the 80th Republican Congress did not get credit for extending Social Security coverage. The House passed a bill to add 2,500,000 persons to the program, but the Senate failed to act because of lack of time. Without doubt, the President will insist upon action this time, with favorable results assured. Increasing of benefit payments (and collections) is also planned, and some knotty problems in collecting from housewives in the event coverage is extended to domestic workers.

Something entirely new in social security legislation (and sometning that may cause more fireworks than expansion of the present program) is a possible request from Oscar Ewing, Federal Security Administrator, for approval of a compulsory health program to be financed through payroll taxes. This program would involve a new series of accident and sickness benefits. Here again is a project embodying much that is desirable, and one that would react to the immediate benefit of H & V readers because of the hospital building program which it would include. The nation's doctors, however, see in it the first steps toward "socialized medicine" and regimentation of the country's physicians and surgeons. Who's right?

Tax Outlook

The foregoing projects are just a few among many that will cause fiscal questions to take the spotlight early in the 81st Congress. With "get it from the government" an increasingly popular theory, it would appear that the expenditure side of the ledger will have new items unless Congress puts on the brakes. Democratic promises, if all enacted, would add an estimated $3 or $4 billion to other government costs. Compensating tax increases would have to come from increased corporation taxes, some new form of excess profits tax, or possibly from an increase in individual taxes.

Tax guessers opine that an excess profiits tax is unlikely; that individual taxes in the lower income levels will remain unchanged, but that rates for corporations and for individuals in the $5,000 and over bracket will carry the load.

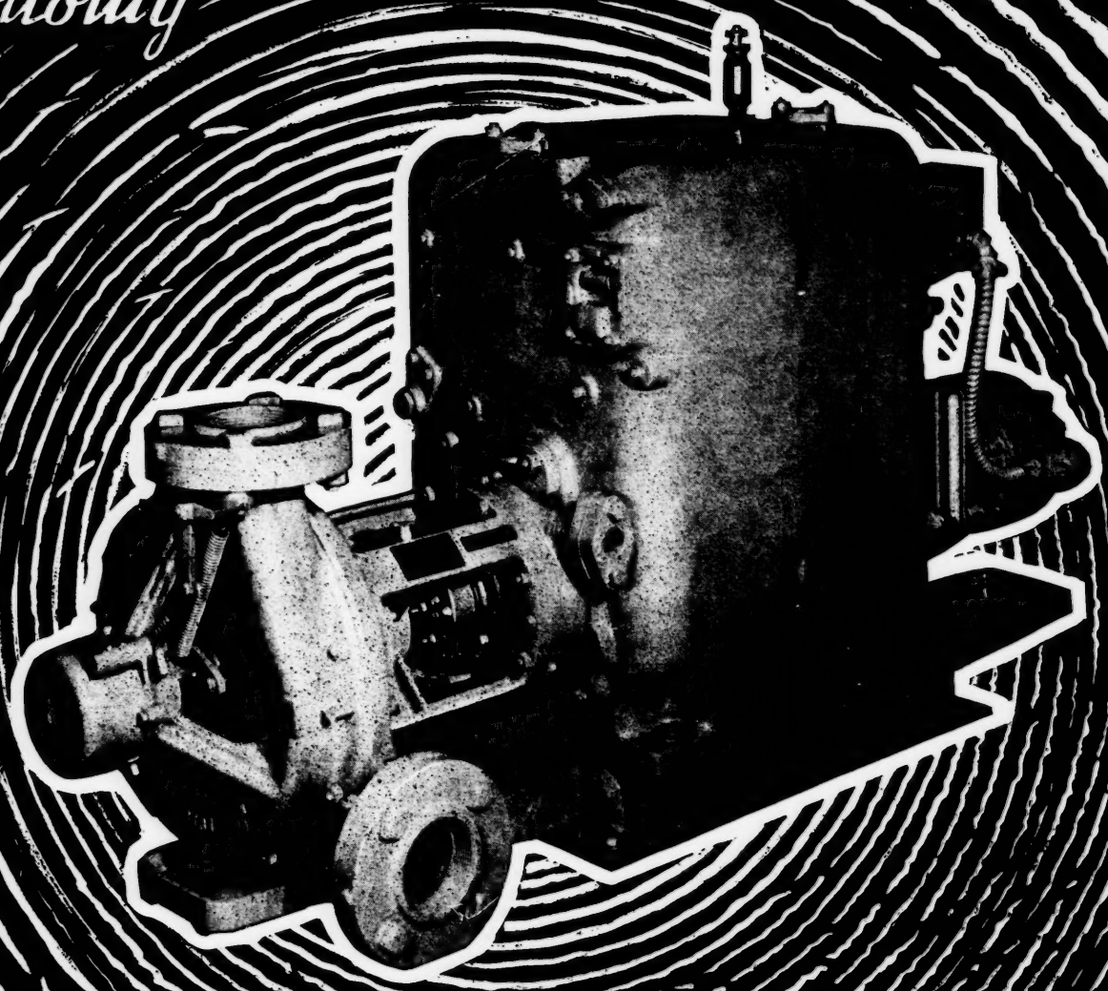
Foreign Aid—Defense

To the campaign promises package must be added some very expensive decisions on foreign aid and national defense. An early decision must be made on whether to continue at $5.3 billion or to raise the second year's contribution to the European Recovery Program. The $5.3 billion figure proved inadequate this year, and in addition, diplomatic leaders are hinting that an additional $1.5 billion for military aid to Western Europe would be most advisable.

Also anticipated is a substantial increase in the $12 billion set aside for this year for our own national defense program. Army, Navy, and Air Force have hinted that $23 billion would be about right. If they must take a lesser amount, it has been indicated that anything below $15 to $16 billion would require sharp curtailment of the 70-Group Air Force authorized by Congress last summer, and in the selective service draft. Not budgeted, but not forgotten, is the universal military training idea.

All in all, the new 81st Congress appears to have plenty of work cut out for it, and it will be interesting to find out whether the so-called mandate to give the voters everything they want also includes the mandate to tap their pocketbooks for enough money to pay for such a program.

Centralized Heating Economy



A RETURN LINE VACUUM PUMP THAT CUTS HEATING COST.

This unusual pump needs no electric current, cutting out greatest item of pump operating expense.

More important, this pump insures absolutely uniform circulation in system. That means continuous steam economy.

Simple, compact, one moving element, no wearing parts, no internal lubrication. Bulletin No. 203 gives the facts. Your copy is waiting.

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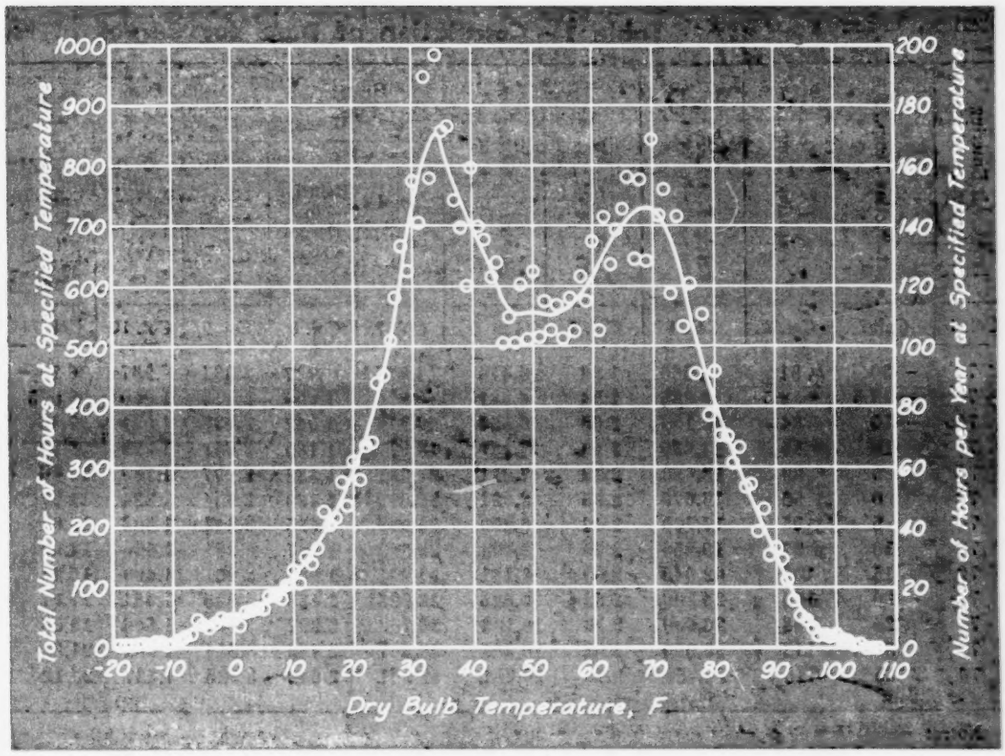


Fig. 1. Dry-bulb temperature frequency curve for Chicago (1935-39 incl.). The original data were plotted at 1 F intervals as shown by the circles. These data were then smoothed by a five-year running average, followed by a second smoothing on a five-year average, the result being the curve shown.

Seasonal Performance Factor of the Heat Pump

WILLIAM PARKERSON
Rate Engineer, Middle West Service Co., Chicago, Ill.

The seasonal performance factor is presented for consideration as the weighted average coefficient of performance throughout the heating season. This factor provides a sound foundation for comparative cost data.

THE coefficient of performance of a heat pump, is a measure of its ability to compete in the heating field with fuel-burning equipment or apparatus. The so-called "C.O.P." is well understood. The theory underlying the coefficient of performance has been copiously treated in the refrigeration industry literature. An appraisal of its theoretically possible and practically probable order of magnitude is available as a guide to conservative design. (See the author's article, Coefficient of the Heat Pump, HEATING AND VENTILATING, May, 1947, pages 63-67). Manufacturers are developing and testing new models. Rapidly rising fuel prices put the buying public in a condition of eager readiness for some such magic answer as the heat pump has been said by some to offer. But can the heat pump compete? This is precisely the crucial question and the very one to which no clear anwer has yet been forthcoming.

Industry Committees have defined with exactness the coefficient of performance. But the coefficient, as so defined, and by every definition, is as of now; as of the hour; as of specific conditions. It is a thing which changes with changing conditions. In trying to set up comparisons of the heat pump with other heating appliances and in attempting to estimate the operating cost of the heat pump over a period of time, need has been felt for a broader concept than the "strait-jacketed" coefficient of performance. Thus, the new term "performance factor" has been introduced to represent or express the weighted average coefficient of performance of a heat pump system over a specified period of time and under varying heat-source conditions.

From a comparative standpoint, the difficulty resides in the dissimilarity of the operating characteristics of a heat pump from those of fuel-burning heating equipment. With the heat pump, and also to a lesser degree with coal-burning equipment, the ratio of heat output to energy input varies as the conditions of the heat source fluctuate—be it earth, air or water. On the other hand, with the common oil or gas furnace or boiler, in which the fire is either full on or off, the ratio of heat output to energy input remains fixed and independent of surrounding conditions.

Now, the introduction of a new term and the very concept which the term is designed to express, are meaningless without some method for employing the concept to advantage, in its related art. If the weighted average coefficient of performance over a heating season — the seasonal performance factor — can be evaluated, then a firm foundation is laid for comparative cost estimates. Otherwise, what good is it to talk glibly of a performance factor in scientific jargon, when a large element of guess remains.

The specific task undertaken in this discussion is to evaluate the seasonal performance factor of an air-to-air heat pump for the Chicago area. If this is in-

Table 1 – Calculation of Data for Curves of Fig. 2

Temp., Air Entering Condenser, F	Sat. Suction Temp., F	Condensing Temp., F	Refrig. Effect, Btu per hr	Power Input, kw (a)	Thermal Equiv. of Power Input, Btu per hr	Heating Effect		Coefficient of Performance		$\Delta t = WB_o - t_r$, F (d)	WB_o, F (e)	Dry-Bulb Temp., F (f)	Required Heating Capacity, Relative	Fraction of Heating Effect Required (g)
						Total Btu per hr	Relative to Design (b)	Actual	Relative to Design (c)					
Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	Col. 8	Col. 9	Col. 10	Col. 11	Col. 12	Col. 13	Col. 14	Col. 15
70	—20	81	8,560	1.88	6,416	14,976	.937	2.334	.967	6.29	—13.71	—13.2	1.043	1.113
70	—17.5	82.5	9,355	1.94	6,621	15,976	1.000	2.413	1.000	6.875	—10.625	—10.0	1.000	1.000
70	—15	84	10,150	2.00	6,826	16,976	1.063	2.487	1.031	7.46	— 7.54	— 6.8	.957	.900
70	—10	86	11,830	2.10	7,167	18,997	1.189	2.651	1.099	8.70	— 1.30	— .3	.871	.733
70	— 5	89	13,680	2.23	7,611	21,291	1.333	2.797	1.159	10.06	+ 5.06	6.5	.780	.585
70	0	92	15,670	2.35	8,021	23,691	1.483	2.954	1.224	11.52	11.52	13.2	.691	.466
70	5	95	17,700	2.42	8,259	25,959	1.625	3.143	1.303	13.01	18.01	20.2	.597	.367
70	10	97	19,850	2.55	8,703	28,553	1.787	3.281	1.360	14.60	24.60	27.2	.504	.282
70	15	100	22,040	2.69	9,181	31,221	1.954	3.401	1.409	16.21	31.21	34.8	.403	.206
70	20	104	24,300	2.82	9,625	33,925	2.123	3.525	1.461	17.87	37.87	41.7	.311	.146
70	25	108	26,600	2.96	10,102	36,702	2.297	3.633	1.506	19.56	44.56	49.2	.221	.096
70	30	112	29,000	3.02	10,307	39,307	2.460	3.814	1.581	21.32	51.32	56.8	.109	.044
70	35	115	31,450	3.15	10,751	42,201	2.642	3.925	1.627	23.12	58.12	64.2	.011	.0042

Notes:
(a) Includes motor input to operate compressor and condenser fan. Evaporator fan not included.
(b) Relative to heating effect at design conditions. (—10F outside air dry-bulb temperature for Chicago.)
(c) Relative to coefficient of performance at design conditions.
(d) Δt = difference between wet-bulb temperature of air entering evaporator and saturated refrigerant suction temperature. Basic rating assumed for evaporator coil = 1,360 Btu per hour per degree temperature difference (Δt).
(e) Wet-bulb temperature of air entering evaporator.
(f) Dry-bulb temperature of air entering evaporator, assuming a relative humidity of 70%.
(g) This also represents fraction of time compressor must run to satisfy requirements at these temperatures.

telligently carried forward to a logical conclusion, it should serve as a model for other such determinations. How shall we proceed?

Temperature Frequency Curve

Some time ago the United States Weather Bureau completed a critical study of its temperature records for Chicago for the five years 1935-1939 inclusive. One of the products of this study was a table giving dry-bulb temperature frequency data by months. Five successive Januarys were consolidated in one column; five successive Februarys in another column; etc. By combining these twelve columns, temperature-frequency data for the five-year period were obtained. These data are plotted as circled points in Fig. 1.

In spite of the fact that the circled points are components of a five-year sample, they form no clear outline. There is a good deal of scatter among the points. But after a smoothing operation is applied to them, the pattern begins to take shape. And when the same smoothing operation is applied a second time, the points fall dutifully into position like so many soldiers on maneuver and produce the curve in Fig. 1. And all this without any appreciable change in the sum total of hours represented. Thus, we now have, for the Chicago area, a clear picture and a detailed schedule of the hours during which the heat pump—or any heating system, for that matter—must operate at every temperature from —15F to 103F inclusive.

A considerable volume might be written about the possible uses of this curve. But in this limited space, suffice it to call attention to its surprising bi-modal shape. Who could predict that its highest peak would occur at 34F? The corresponding temperature frequency curve for New Orleans, shows only one major peak, namely at 76F, and no irregularity in the neighborhood of freezing temperatures. Probably the 34F peak in Chicago is caused by the presence of a thick blanket of snow and ice which, acting as a negative radiator or heat sink, retards the rise of temperatures in the early spring, and causes the thermometer to hover near the freezing zone when temperatures would otherwise be higher, were it not for the influence of melting ice and snow.

Percent Running Time

While the curve of Fig. 1 shows the number of hours during which a heating system must operate, it does not show the running time thereof. That involves also the ratio of capacity required to capacity available, which is the same as the fraction of elapsed time the machine must run. For these considerations we turn now to Fig. 2 and Table 1.

It is necessary to know:

(1) How the required heating capacity varies with changes in outdoor temperature;

(2) How the heating capacity of the heat pump system changes as the outdoor temperature changes;

(3) How the ratio of required heating capacity to available heating capacity varies, as determined from (1) and (2); and

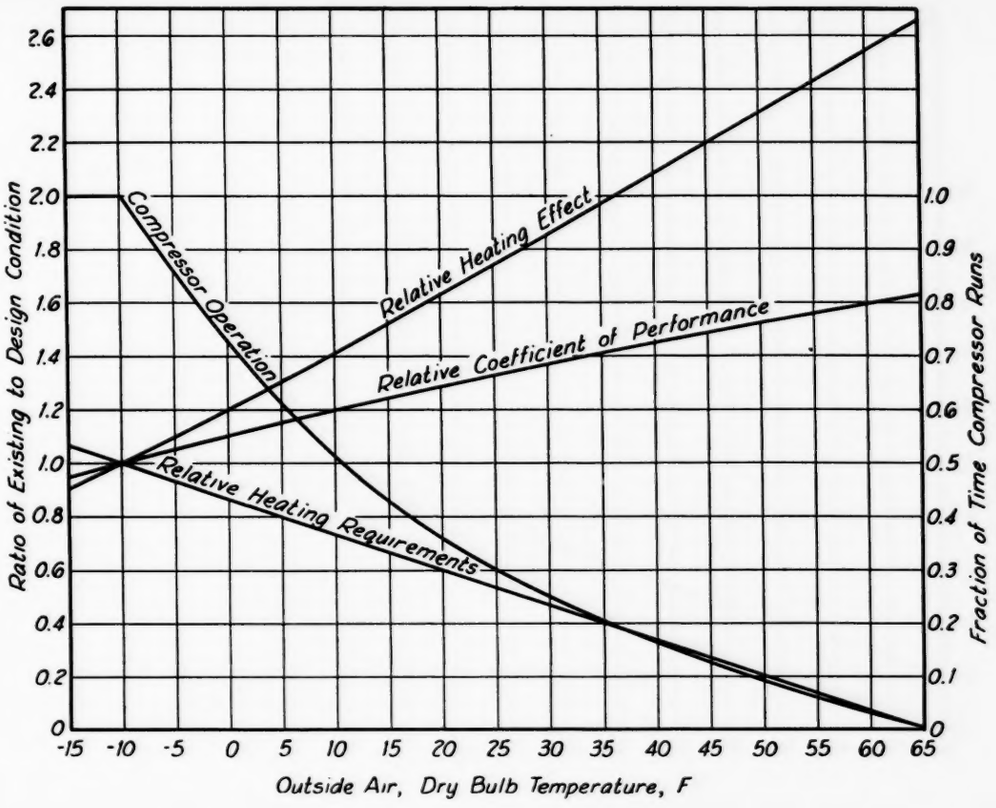


Fig. 2. Heat pump operation relationships based on data in Table 1.

(4) How the coefficient of performance varies with changes in the outdoor temperature.

These four points will now be presented in greater detail.

(1) Required Capacity vs Outdoor Temperature. If the required capacity at design condition for Chicago (—10F) be taken as unity, a straight line drawn through that point and zero capacity at 65F gives the desired curve of relationship shown as Relative Heating Requirements in Fig. 2.

(2) Available Capacity vs Outdoor Temperature. The necessary calculations for establishing this relationship are carried out in Table 1. The first five columns of this table are copied directly from a recent data sheet of a prominent refrigeration manufacturer, except the second line, which is an interpolation. A detailed explanation of all of the calculations in this table does not seem warranted—most of them are quite simple. However, the following comments are in order:

a. The indicated condensing temperature is manifestly too low to be effective for heating. But this is merely a matter of design. We are not interested here in the absolute values of heating effect, and coefficient of performance, but only in their relative values as compared with their values "at design." We want to know the shape of the curve; how the function varies with outdoor temperature.

b. Heating effect was figured as though all of the motor input to operate compressor and condenser fan, were converted into useful heat. This is probably not justified, nor is it proper to omit the input to the evaporator fan motor. Expediency is the only defense for these inaccuracies, which, however, should not be large.

c. In calculating the dry-bulb temperature of outside air corresponding to the wet-bulb temperature already found, a relative humidity of 70% was assumed, as representing the approximate average year-round humidity in Chicago. When the calculations of Table 1 have been completed, the desired curve of relationship may be obtained by plotting the figures in column 8, headed Heating Effect; Relative to Design, against those in column 13, headed Dry-Bulb Temperature. This curve is shown as Relative Heating Effect, in Fig. 2.

(3) Required Capacity vs Available Capacity. Now, when the figures in column 14 of Table 1, headed Required Heating Capacity, Relative, are divided by those in column 8, headed Heating Effect; Relative to Design, the figures in the last column of Table 1 are obtained. These figures represent the fraction of the available heating capacity which is required in order to satisfy the heating demands of the space to be heated, for the sundry outside dry-bulb temperatures listed in column 13 headed, Dry-Bulb Temperatures. By plotting the last column of figures against those in column 13, we acquire the curve titled Compressor Operation in Fig. 2.

(4) Coefficient of Performance vs Outdoor Temperature. Now, the coefficient of performance as shown in columns 9 and 10 of Table 1 are secured by dividing the figures in column 7, Total Heating Effect, by those in column 6, Thermal Equivalent of Power Input, and then converting to an index basis by using the C.O.P. "at design" as unity. The curve marked Relative Coefficient of Performance in Fig. 2, results from an obvious plotting operation.

Compressor Operation in Hours

In Fig. 3 appear duplications of two curves already presented, namely, curve *A* is a duplication of the curve in Fig. 1; curve *B* is a duplication of the Compressor Operation curve in percent as already presented in Fig. 2.

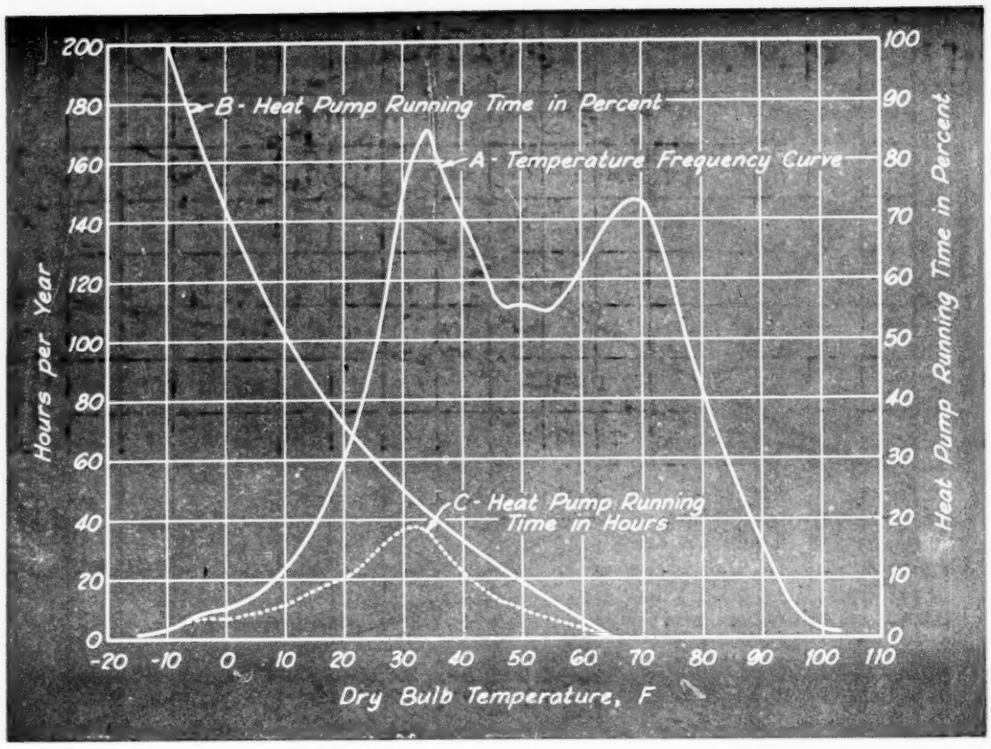


Fig. 3. Development of curve to show heat pump running time in hours.

It is obvious that if the percentages from curve *B* are applied to the elapsed hours indicated by curve *A*, the result will be the actual compressor running time in hours for each indicated outside dry-bulb temperature shown on the base-line. This application of the percentages of curve *B*, to the elapsed hours of curve *A*, results in curve *C*, the Heat Pump Running Time in Hours. Thus we find, for instance, that an air-to-air heat pump in Chicago, designed to meet heating requirements at —10F, will have a total running time of 38 hours per year at 32F outside temperature.

Seasonal Performance Factor

As previously explained, the seasonal performance factor is nothing other than the weighted average coefficient of performance for a season's operation. The hours of curve *C*, Fig. 3, may be used for weighting the relative coefficients of performance from Fig. 2. In this manner, the weighted average coefficient of performance (relative) may be obtained. This will be, as explained earlier, the seasonal performance factor of an air-to-air heat pump in Chicago.

Calculations were carried on, throughout the temperature range from —15F to 65F. For every temperature in this range, the hours taken from curve *C*, Fig. 3, were multiplied by the relative coefficient of performance taken from Fig. 2. All these products were added together to give a total of 7,853.50. Likewise, the total number of hours under curve *C*, Fig. 3, were read and summarized to 5,834.96 hours. When this figure is divided into the product-summary, we arrive at a seasonal performance factor—that is, a weighted average coefficient of performance of 1.346, which is the same as that shown on Fig. 2 at 27.5F.

Thus, if the coefficient of performance of an air-to-air heat pump designed to meet heating requirements at —10F in Chicago is known to be, say, 3.0 for 27.5F outside air entering the evaporator, then 3.0 may be relied upon as representing the seasonal performance factor of that unit in Chicago during a normal heating season.

If the manufacturer will test his unit and specify coefficient of performance at the stated temperature for a given city, that coefficient of performance may be used as the seasonal performance factor in any cost comparisons, or cost estimates that are required to be made.

This analysis was undertaken to determine the relationship between seasonal performance factor and coefficient of performance for only one type of heat source, namely, air. However, it seems obvious that the same type of procedure may be applied where the source of heat is well water, river water or lake water, on which temperature records exist. Moreover, it is hoped that this analysis may provide at least a guide in studying the relationship between seasonal performance factor and coefficient of performance in ground-coil installations. Here, of course, heat-source temperatures will not be so easy to determine or correlate, and will be very largely affected by the size and character of the installed heat-pump system.

Conclusion

To sum up the findings of this study, it appears:

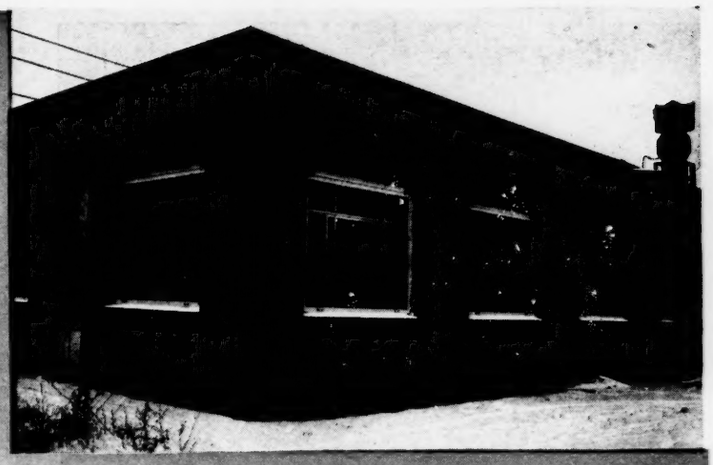
(1) The seasonal performance factor must be recognized as the weighted average coefficient of performance throughout the heating season.

(2) Temperature frequency data are even now available in 117 cities in the United States by the manipulation and correlation of which, proper weighting factors may be found to apply to coefficient of performance to secure seasonal performance factors for air-to-air units.

(3) By proper analysis of temperature frequency data, it should be possible to specify the "basic" temperature for air-to-air heat pumps for each city of this group. Manufacturers of air-to-air heat pumps must test their equipment and publish curves of relationship between guaranteed coefficient of performance and temperature of air entering the evaporator coil.

(4) The coefficient of performance selected from manufacturer's curves at the said "basic" temperature for the type and model of heat pump installed, would then represent, with a close degree of reliability, the seasonal performance factor for the given city and the given heat pump.

Tests Show Limits in Rating Floor Panels



Metallurgical Laboratory at Revere Copper and Brass Incorporated, where panel rating tests were carried out.

D. L. MILLS,* L. J. LATART,* and F. W. HUTCHINSON**

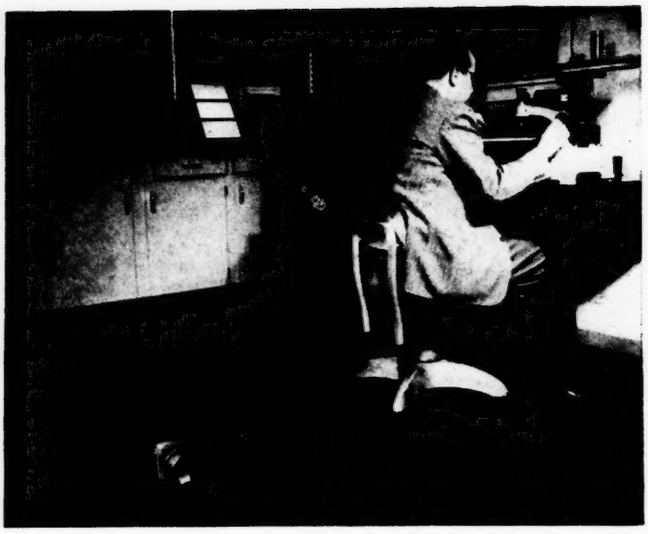
Tests of three actual panels in service are described and conclusions drawn regarding probable output.

IN the design of any type of heating system the first problem is that of determining the rate at which heat must be supplied to the structure, and the second problem is that of providing sufficient transfer surface to assure delivery of heat at the required rate. With radiant heating, more than with other types of heating systems, these two problems are not separable since it can be shown (1)[1] from theory that the rating of a particular panel—operating at fixed temperature in a comfortable room—will vary with the structural and ventilation characteristics of that room. Thus for design conditions corresponding to an outside air temperature of 30F and a floor panel surface temperature of 80F, analysis will show (2) that the rating of the panel will vary with the type of structure and the amount of ventilation from a low of 34.5 Btu per (hr) (sq ft) of panel surface to a high of 38.5 Btu per (hr) (sq ft); a rating change in excess of 10%. For correct design it is thus evident that a fixed panel rating cannot be used with accuracy; some of the published design procedures, including those in reference (2), take account of the variation in rating and apply it in evaluating the required size of panel.

In spite of the above disadvantages it is frequently desirable in practice to keep in mind some average value of a rating which can be used as a rough check or for making preliminary estimates of required panel size. Many and widely varying recommendations have been made concerning the ratings of floor-type radiant panels, but very little data are available in the published literature to support or to substantiate the recommended values. For floor panels operating at 85F design temperature in a room with 70F air and 70F mean radiant temperature, claims have been made of ratings as high as 90 to 100 Btu per (hr) (sq ft), but—insofar as the authors have been able to determine—there are no published records of the field tests or the laboratory experiments which justify these extraordinarily high ratings. For the conditions stated above, a panel rating of 90 Btu per (hr) (sq ft) would require that the combined equivalent film coefficient for transfer from floor panel to its surroundings be of the order of $90/(85—70) = 6$ Btu per (hr) (sq ft) (F); such a value might be anticipated if the air velocity *within the room* were of the order of 15 miles per hour, but for normal air movement in an occupied space such a claim is fantastically at variance with expectancy as based on published laboratory data.

The great majority of recommendations for floor panel ratings are based on calculation from the experimentally determined convection coefficients presented in the 1938 paper (3) of Wilkes and Peterson. These investigators used a relatively large flat surface in their tests and conducted the work under conditions of no air movement. Based on their results the convection coefficients which have been widely used in panel heating analysis and design are 0.4 Btu per (hr) (sq ft) (F) for a ceiling panel, 0.7 Btu per (hr) (sq ft) (F) for a wall panel, and 1.1 Btu per (hr) (sq ft) (F) for a floor panel. Radiant transfer is not a function of surface position (except insofar as the angle factors may vary in an actual installation) hence the equivalent coefficient for radiation will be the same for wall, floor, or ceiling panels. In the usual range of temperatures an average value of the equivalent radiant film coefficient is unity, hence the combined equiva-

*Research Department, Revere Copper and Brass Incorporated, Rome, N. Y.
**Professor of Mechanical Engineering, University of California, Berkeley, Calif.
[1]Numbers in parentheses correspond to references listed at the end of this article.



Part of test room No. 1. Note workbench enclosed to floor and instrument on floor in foreground

lent film coefficients for ceiling, wall, and floor panels are 1.4, 1.7, and 2.1 Btu per (hr) (sq ft) (F), respectively. For *any* inside surface, irrespective of its orientation, the ASHVE *Guide* uses 1.65 Btu per (hr) (sq ft) (F) as the combined film coefficient, and it is this value which has been used in calculating the many hundreds of U values that appear in the *Guide*.

The importance of accuracy in the inside film coefficient applies to all types of heating systems, but it is interesting to note that if the selected value is too small the error will provide a factor of safety in rating a heating panel, but will be non-conservative with respect to load determination. Thus if the film coefficients of the order of 6.0 which have been claimed for some floor panels were found to be correct it would follow that a wall which the *Guide* now lists as having a U of 0.25 would actually have a U of approximately 0.28, hence would lose 12% more heat than present calculations show. On the other hand, a floor panel rated by use of the 2.1 coefficient would obviously be conservative (by almost 300%!) as compared with one rated on the basis of 6.0. From these considerations it is evident that need exists for a check on the values of film coefficients which are actually occurring on installed floor-type radiant panel heating systems.

Experimental Set-Up

In order to check actual performance against theoretical expectancy, individually controlled floor panels in each of three rooms in an occupied building were tested. Before discussing the test conditions, attention should be specifically called to the very important fact that the results of tests of this kind are entirely independent of the method used to liberate heat within the structure of the panel. Whether air, steam, water, or electricity provides the energy and whether copper tube or iron or steel pipe is used, the results should be the same since consideraton is limited to just three things: (1) The amount of heat delivered to the panel; (2) The average surface temperature of the panel; (3) The average air temperature within the room. Likewise, neither the diameter nor the spacing of tubes should have any effect on the results providing only that the surface of the panel is heated to a reasonable degree of uniformity.

The three systems on which experiments were conducted all used hot water in ¾-in. copper tube (⅞-in. O. D.) spaced on 9-in. centers. In system number one the depth from panel surface to the top of the tube was ½ in., whereas in systems number two and three the corresponding depth was 1 in. and 2 in. respectively. All coils were installed in uncovered 4-in. concrete floors poured over gravel fill. The three systems exist in rooms located within the same building and detailed descriptions of the entire heating plant are available in a series of articles (4) which were published at the time the structure was erected. The building is 25 ft × 60 ft and houses the metallurgical section of a research department. The three rooms in which the present tests were conducted are all in regular use and are occupied by workers who had no connection with, nor interest in, the heating research, hence were primarily, and rightly, interested in their own comfort. Air temperatures maintained within the rooms were selected by the occupants and may therefore reflect personal idiosyncracies. Thus in every respect the three systems are actual, operating, field installations of floor-type radiant heating and test results from them should therefore be indicative of what can be expected from any other practical, full-scale, installation.

The problem of obtaining laboratory accuracy on field tests is always one of great importance. In the present case a solution was extremely simple since the field tests were anticipated at the time the building was erected and provision was made then for measurement of flow rates and of various temperatures. Thermocouples were embedded in the various surfaces and a 16-point recorder was used to provide a continuous record for an extended period preceding each test; in this way it could be ascertained with finality that steady state conditions existed during the periods from which data have been selected for analysis.

Assumptions and Calculations

The total energy supplied to each system was determined by recording the flow rate to that system, W pounds per hour, and the temperature of the water entering the coils, t_e, and leaving the coils, t_l. The rating of the panel Q_p in Btu per (hr) (sq ft), including losses from the rear is then,

$$Q_p = W(t_e - t_l)/A_p \qquad (1)$$

where A_p is the panel area.

A true panel rating, however, would be based only on energy actually supplied to the occupied space, hence Q_p should be corrected for losses from the rear of the panel to the ground. Further, in most actual rooms some sections of the floor are likely to be covered with built-in cabinets or other obstructions while other areas may be partially covered. If the influence of obstructed areas were not taken into account the resultant over-all rating would obviously be lower than could be expected from a fully exposed panel; since the intent in this paper is to investigate the possibility of

realizing the large ratings that have sometimes been claimed, it is considered conservative to fully account for obstructed areas. To do this—as well as to account for rear losses—some assumptions must be made. Thus for purposes of analysis in this paper it is assumed that:

(1) Losses to the ground are 10% of the rate of energy dissipation from the heating surface of the panel to unobstructed surroundings *in these particular cases.*

(2) Panel surface which is covered by furniture or cabinets that extend all the way to the floor loses, to the room, 10% as much energy as does unobstructed panel area.

(3) Panel surface which is covered by furniture that extends to within 2 in. of the floor loses 20% as much energy to the room as does unobstructed panel area.

(4) Panel surface under ordinary furniture, as chairs, tables, and unenclosed workbenches loses energy to the room at the same rate as unobstructed panel area.

Now let R denote the corrected rating, Btu per (hr) (sq ft), of unobstructed floor panel surface and note that:

$1.1R$ = Total energy loss (1.0 for loss to room + 0.1 for loss to ground) of unit area of unobstructed panel.

$0.2R$ = Total energy loss of unit area of covered (assumption 2) panel.

$0.3R$ = Total energy loss of unit area of unobstructed (assumption 3) panel.

Then if unobstructed, covered, and obstructed areas are taken respectively as A_u, A_c, and A_o and if the total panel area is A_p it follows that,

$$(1.1RA_u + 0.2RA_c + 0.3RA_o)/A_p = Q_p \qquad (2)$$

Combining equations 1 and 2,

$$R(1.1A_u + 0.2A_c + 0.3A_o) = W(t_e - t_l) \qquad (3)$$

or

$$R = W(t_e - t_l)/(1.1A_u + 0.2A_c + 0.3A_o) \qquad (4)$$

Equation (4) gives the corrected panel rating for conditions of the particular test. To permit generalization it will be advantageous to determine the combined equivalent film coefficient from R and from a knowledge of the average surface temperature of the panel, t_s, and the air temperature within the room, t_a:

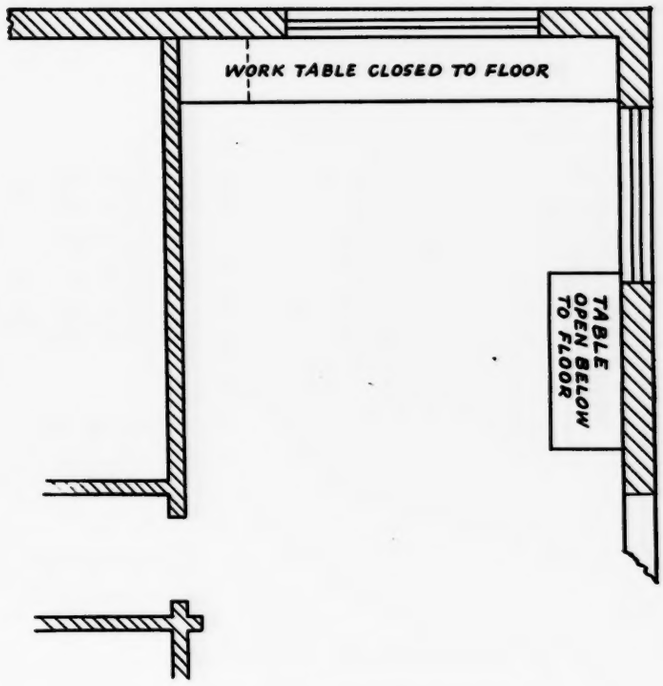
$$h = R/(t_s - t_a) \qquad (5)$$

Experimental Results

System 1. This system, using ½-in. depth of bury is installed in a room having a total floor area of 220 sq ft. The heating panel consists of a single sinuous coil of ¾-in. copper tube on 9-in. centers; 14 rows wide by 11 ft long over the return bends. Panel area, A_p, is 118 sq ft with approximately 154 linear feet of tube. The area of the floor slab in which the panel is located is 144 sq ft. On one side is a worktable with cabinets under it that extend to the floor and cover 8 sq ft of panel. There is no other obstructed panel area so:

$$A_u = 110 \; A_c = 8 \; A_p = 118$$

At the time of the test steady state was known to exist



Floor plan of test room No. 1.

and the temperature of the panel surface was determined at the center of each quadrant and at the center of the panel itself; the resultant average surface temperature is then,

$$t_s = (81 + 77 + 78 + 81 + 80)/5 = 79.4F$$

Room air temperature, t_a, was taken 48 in. above the floor and found to be 68F. Flow rate was measured in gallons per minute and converted to pounds per hour giving $W = 491$. Entering and leaving water temperatures were determined by means of calibrated thermocouples located in thermometer wells giving: $t_e = 97.5F$, $t_l = 89F$.

Substituting the above experimental data into equation (4),

$$R = 491(97.5 - 89)/(1.1 \times 110 + 0.2 \times 8) = 34.0$$

and by substititution into equation (5),

$$h = 34.0/(79.4 - 68) = 2.98 \text{ Btu per (hr) (sq ft) (F)}$$

System 2. This system, using 1-in. depth of bury, is installed in a room having a total floor area of 144 sq ft. The heating panel consists of a single sinuous coil of ¾-in. copper tube on 9-in. centers, 14 rows wide by 11 ft long. Panel area is 118 sq ft with approximately 154 ft of tube. Covered area under a partition and under large worktable legs amounts to 7 sq ft, whereas obstructed area under cabinets that come to within 2 in. of the floor, is 5 sq ft; thus:

$$A_u = 106; \; A_c = 7; \; A_o = 5$$

Steady state existed at the time of the test and the panel surface temperature was measured at six points giving,

$$t_s = (85 + 82 + 86 + 85 + 85 + 85)/6 = 84.7F$$

Other experimental values were:

$$t_a = 76; \; t_e = 97.5; \; t_l = 91; \; W = 491$$

Then from equation (4),

$$R = 491(97.5 - 91)/(1.1 \times 106 + 0.2 \times 7 + 0.3 \times 5) = 26.7$$

and: $h = 26.7/(84.7 - 76) = 3.06$

System 3. The third system, using 2-in. depth of bury, is installed in a room having a total floor area of 482 sq ft. There are two coils with combined panel area of 214.5 sq ft and with approximately 99 sq ft of heating surface covered by worktables and sinks which are over cabinets that extend down to the floor; thus:

$$A_u = 115.5; \quad A_c = 99$$

Due to changing weather conditions prior to the time of the test on this system it was not possible to realize an exact condition of steady state. Data reported here were obtained from three sets of readings, each set taken at the end of successive 45-minute intervals so the averaged values represent a combined test period of approximately two hours; maximum variation of any particular temperature throughout the test period was 1.5F. The surface temperature of the panel over each of the heating coils was so nearly the same that a single value of t_s has been taken as valid for the panel as a whole,

$$t_s = (88.0 + 88.0 + 87.0) + (88.0 + 88.0 + 87.0) + (87.0 + 86.5 + 86.0) + (85.0 + 85.0 + 84.5) + (88.0 + 88.5 + 88.0) + (88.0 + 88.0 + 87.0) + (88.0 + 88.0 + 87.0) + (88.5 + 88.5 + 88.0) + (89.0 + 89.0 + 89.0)/27 = 87.5F$$

where each parenthesis includes the three test readings of a single thermocouple.

The two heating coils, identified as 1 and 2, received water as follows:

For coil 1

$W = 375.5$ lbs/hr

$t_e = (98.5 + 96.5 + 98.0)/3 = 97.7F$

$t_l = (94.5 + 93.0 + 93.0)/3 = 93.5F$

For coil 2

$W = 650.3$ lbs/hr

$t_e = (98.0 + 98.0 + 98.5)/3 = 98.2F$

$t_l = (96.0 + 95.5 + 95.5)/3 = 95.7F$

The air temperature was the same for both regions of the room and averages to:

$$t_a = (78.5 + 78.0 + 77.0)/3 = 77.8F$$

Then substituting into equation (4),

$$R = 375.5(97.7 - 93.5) + 650.3(98.2 - 95.7)/1.1 \times 115.5 + 0.2 \times 99 = 21.8$$

and

$$h = 21.8/(87.5 - 77.8) = 2.25$$

Discussion of Results

The film coefficients resulting from these three tests are intended for qualitative rather than quantitative consideration. Since the object of this investigation was to explore the possibility of realizing very high ratings from floor panels the assumptions which underlie the calculations have credited a maximum of energy transfer to unit area of unobstructed panel. Thus, upward loss from covered panel areas has been taken as 10% of rating, but since such covered areas usually occur under workbenches and cabinets that are located along exterior walls it is highly probable that the actual upward loss exceeds the assumed value.

Similarly, the panels tested in all three of these systems did not occupy 100% of floor area, hence there was appreciable loss from the panel boundaries by conduction to the adjacent unheated concrete slab. This loss was not considered, hence the energy actually lost by conduction has been credited to surface dissipation and has increased the calculated value of the film coefficient. Finally, the tests were conducted during the first few months after the structure had been constructed and there is every reason to believe that losses from the rear of the panel to the ground were in excess of the assumed value of 10%. Actually, ground loss undergoes a long-term transience which does not appreciably affect the short-term steady state test, but such losses will be abnormally great during the first half of the first heating season.

All of the above factors lead to an expectation that the film coefficients calculated from these three tests are somewhat higher than the values which can actually be obtained from a floor-type heating panel.

Summary

Based largely on the laboratory work of Wilkes and Peterson many existing design procedures for radiant heating use a combined radiation and convection film coefficient of 2.1 Btu per (hr) (sq ft) (F) temperature difference between the surface of a floor panel and the temperature of the room air at the breathing level. For panels designed for 85F maximum surface temperature in a room at 70F, the above coefficient gives a maximum expected rating of the order of 30 Btu per (hr) (sq ft). Frequent claims have been made that floor ratings of the order of 90 Btu per (hr) (sq ft) have been obtained in practice, but—to the authors' knowledge—no substantiating test data have been published.

This paper reports tests of three systems under controlled experimental conditions. Necessary assumptions concerning rear losses, end losses, and reduced surface loss due to obstructions have in each case favored higher net rating so it is believed that the ratings which have been obtained are unconservatively high. The results are intended only for qualitative use, but they appear to establish—for the three typical field systems which were tested—that the claimed ratings of 90 Btu per (hr) (sq ft) are over 200% of the actual ratings obtained experimentally from these three installations. The authors conclude that extreme caution should be used in using floor panel ratings (for 85F design temperature) that exceed 40 Btu per (hr) (sq ft).

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Solar Radiation During Cloudless Days

SIGMUND FRITZ
U. S. Weather Bureau

Measurements and estimates of the amount of solar radiation which is received at various places on the earth during each month of the year are required for many purposes, by agricultural, meteorological, and industrial groups, to mention a few. This report contains estimates of the radiation present on cloudless days in the United States in order to serve these groups immediately and to comprise the first step in the evaluation of radiation for all days. A study of the "all day" radiation is now being undertaken.

IF solar radiation measurements are available from several places, and if estimates of the amount of atmospheric water vapor are available at those same places and numerous additional ones, the amount of solar radiation which reaches a horizontal surface at the ground everywhere on cloudless days can be computed. In 1919, Kimball (1)[1] plotted charts of such radiation, utilizing the few solar radiation measurements which were available at that time and making use of surface observations of vapor pressure to estimate the amount of water vapor in the atmosphere. Since more numerous solar radiation measurements are available now, and since a better estimate of atmospheric water vapor can be made from aerological observations, it is possible to construct more accurate charts of cloudless-day radiation.

Construction of Auxiliary Graph

To facilitate the computations, an auxiliary graph was constructed from which the radiation during any minute could be obtained. From Klein's (2) equations for radiation received on a horizontal surface, it is easy to arrive at the equation

$$Q_m = 1.94\left(\frac{r_o}{r}\right)^2 \cos Z\,(a''_m + .5 - .5\,a'_m) - D_m \quad (1)$$

where the symbols have the following meanings:

Q_m = total radiation per minute on a horizontal surface from sun and cloudless sky, gram calories per sq cm, (to convert to Btu per sq ft, multiply by 3.68.)
r_o = mean distance between earth and sun
r = actual distance between earth and sun
Z = zenith distance of the sun or angle of sun's rays with vertical
a'_m = fraction of energy transmitted through the moist clean atmosphere considering depletion by scattering only
a''_m = fraction of energy transmitted through the same atmosphere considering both scattering and absorption
D_m = term including miscellaneous factors such as dust depletion and effect of ground reflection

Subscript m means that the symbol is to be taken at a particular optical "air mass," which is merely the path of light through the atmosphere referred to the vertical path as unity. The factor 1.94 in equation (1) is the solar constant, 1.94 ly per min, where the "ly" (an abbreviation for langley) is a gram calorie per sq cm (3). To obtain the number of Btu per sq ft, multiply the number of ly units by 3.68.

At sea level, where the atmospheric pressure is about 1,013 millibars, the "air mass" (m_s) is given very closely by: $m_s = \sec Z$, for values of Z up to 80°. At a place where the pressure is p the air mass (m_p) is:

$$m_p = \frac{p}{1{,}013} \times m_s = \frac{p}{1{,}013} \sec Z \quad (2)$$

or

$$\cos Z = \frac{1}{m_p}\,\frac{p}{1{,}013}$$

Substituting this expression for cos Z in equation (1),

$$Q_m = \left(\frac{r_o}{r}\right)^2 \times \frac{p}{1{,}013}(F'_m) - D_m \quad (3)$$

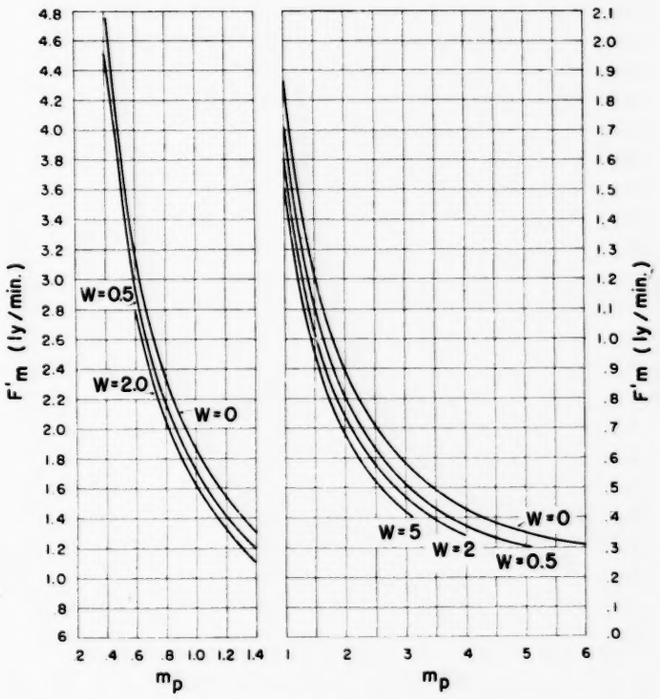


Fig. 1. Relation between F'_m and m_p for selected values of w (in cm.). The left-hand portion of the figure is plotted with an expanded scale of abscissas.

[1]Numbers in parentheses indicate references listed at end of article except where they are obviously equation numbers.

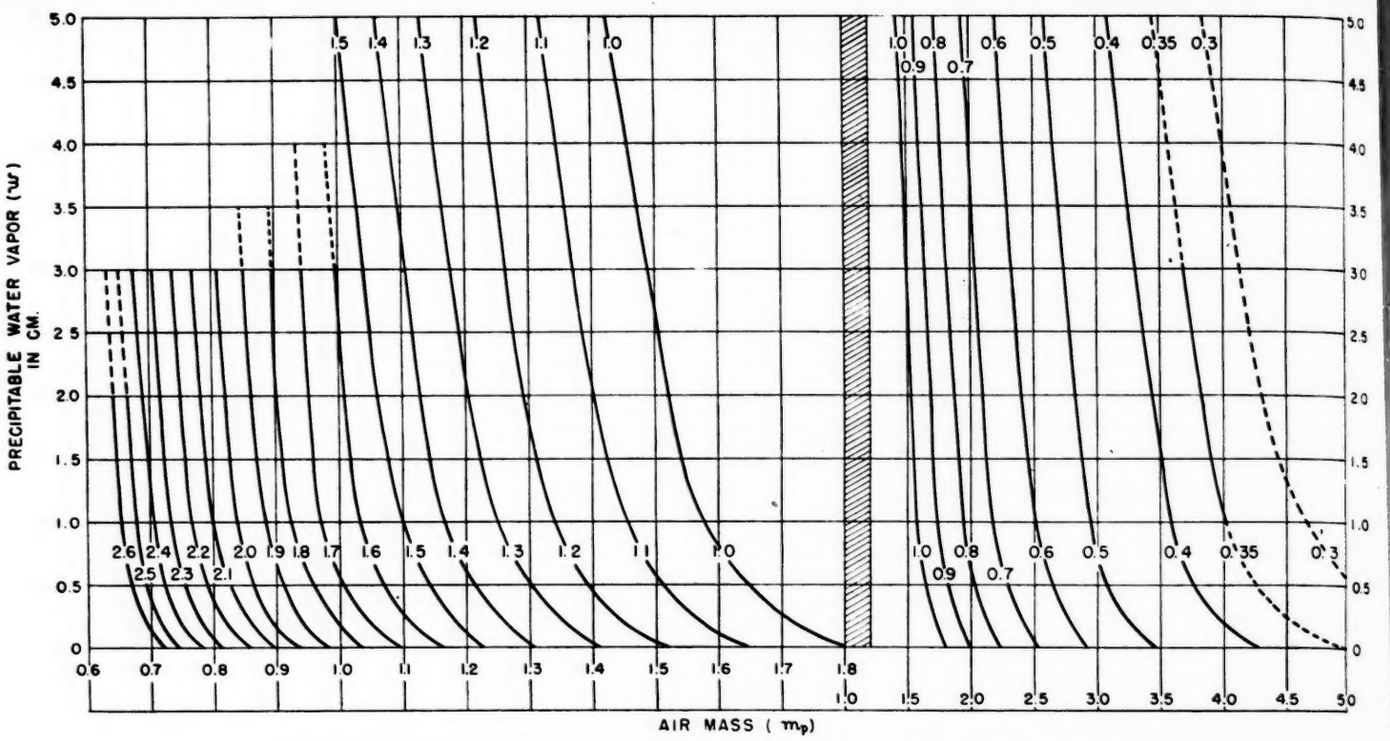


Fig. 2. Intensity of solar radiation in ly per minute (figures inserted on curves) on a horizontal surface through a cloudless, dustless atmosphere as a function of w and m_p. Left-hand portion has been plotted with an expanded scale of abscissas.

where

$$F'_m = \frac{1.94\ (a''_m + .5 - .5a'_m)}{m_p}$$

To obtain the daily total of solar radiation for the fifteenth day of each month we require the summation of Q_m over the hours between sunrise and sunset. This, according to equation (3), will be the summation of F'_m, corrected as shown for altitude and solar distance, minus the total effect of D_m over those hours and may be expressed

$$Q = F - D \qquad (4)$$

where Q is the daily total radiation, F is the corrected summation of F'_m and D is the summation of D_m.

The integrations are performed from sunrise to sunset for the appropriate day. Now a'_m and a''_m depend only on the optical air mass and on the amount of precipitable water vapor[2] (w) in the cloudless atmosphere, so that at a given place F'_m is a function of m_p and of w only.

In order to evaluate F'_m, the transmissions a'_m and a''_m must be determined, and these were obtained from a chart which Kimball (4) published, relating those transmissions to m_p and w. For specific values of w, F'_m was calculated (as shown in Table 1 for w = 2 cm.) and plotted in Fig. 1. (Curves for w = 0.2, 1.0, and 3.0 were used in the original computations, but have been omitted from Fig. 1.) From Fig. 1, the data were retabulated according to values of F'_m and finally plotted as in Fig. 2. If the total precipitable water vapor and the air mass are known for a station near sea level, Fig. 2 can serve as a means of approximating the intensity of solar radiation through a cloudless, dustless atmosphere at the equinox. The graph will give an estimate throughout the year if the change of distance between the earth and sun is neglected (a change in radiation of about ± 3.5% from that at mean distance). Should the station be considerably higher than sea level, the values from Fig. 2 must, of course, be multiplied by p/1,013 to obtain radiation values.

For example, a rough estimate of solar radiation available in the suburbs of New York City (latitude 41°N) at noon on a cloudless January 15 would be as follows:

(1) Assume w = 0.5 (a moderately low value for winter).

(2) Zenith distance (Z) equals 90° minus solar altitude and, referring to *Heating and Ventilating's Engineering Databook*, page 6-14, find a solar altitude for the conditions described of 28° and a secant (1/cos) of (90° — 28°) of approximately 2.1.

(3) Then if m_p = sec Z = 2.1 and w = 0.5 cm
F'_m = 0.77 ly per min (Fig. 2)
and
3.68 F'_m = 2.8 Btu per (min) (sq ft).

Assuming w = 2 cm (a high value for January at New York City) gives the following:

w = 2
m_p = 2.1
F'_m = 0.70 ly per min
3.68 F'_m = 2.6 Btu per (min) (sq ft).

Note that this result is only about 10% lower than that for w = 0.5.

[2]Precipitable water vapor is expressed (in this article) in centimeters and is defined as the depth of liquid which would result if all the water vapor in a vertical column of air of unit cross section (1 sq cm) and atmosphere-high were condensed and collected at the bottom. Data for the concept are obtained from upper air soundings and values for the monthly mean of such vapor for 29 stations can be obtained from the Hydrometeorological Section, U. S. Weather Bureau.

Table 1 – Calculation of F'_m for $\underline{w} = 2.0$ cm.

m_p	a″	a′	F'_m ly/min
0.4	.859	.937	4.32
0.6	.820	.910	2.79
0.7	.803	.899	2.36
0.8	.790	.886	2.06
1.0	.761	.863	1.609
1.2	.737	.843	1.319
1.4	.712	.825	1.109
1.6	.691	.808	.952
1.8	.672	.790	.838
2.0	.654	.773	.745
2.4	.620	.742	.609
3.0	.575	.703	.467
3.4	.548	.680	.404
4.0	.511	.648	.334

Application of Observed Data

To apply Fig. 2 with more refinement, more accurate values of w and m_p must be obtained. Let w' designate the monthly mean of the precipitable water vapor in the atmosphere for all days, and let w designate the same mean for cloudless days only. The Hydrometeorological Section of the U. S. Weather Bureau has computed values of w' from the data for each of the 29 U. S. aerological stations which appear in Ratner's (5) summary. On the basis of European data Humphreys (6) found that $w = 0.87\ w'$. To check whether values in the United States might differ from European ones, a detailed study for January was made for Omaha and Oakland, the former representing a continental climate, and the latter a maritime one. The following ratios of w/w' were found:

Oakland 0.83 Omaha 0.86

Consequently, the values of w' were multiplied by 0.85 to obtain w.

From the known latitude of the aerological stations, the solar altitude for each hour angle of the fifteenth day of each month was computed with the aid of charts described by K. Schutte (7); from the solar altitude, the air mass (m_s) was easily found from Hand's (8) tables, and the corrected air mass (m_p) was obtained according to equation (2) by multiplying m_s by p/1,013 where p was obtained from Ratner's summary.

On the assumption that the monthly mean of w was representative of the fifteenth day of the month, and that the diurnal variation of w was negligible, the values of w and m_p were used with Fig. 2 to obtain F'_m for each hour angle of the fifteenth day of each month. From these values of F'_m, the mean value of F'_m during each hour was obtained, and these average hourly values of F'_m (multiplied by 60) were summed to obtain the daily values, which were then multiplied by $(r_o/r)^2$ and p/1,013 as indicated in equation (3). The values of F'_m were not computed for the hour following sunrise nor for the hour preceding sunset, because Kimball's chart does not extend beyond $m_p = 4$, and because m_s does not equal sec Z for low solar altitudes. Instead, the observed values of radiation for those hours, on days when the radiation was high at stations in the appropriate latitudes, were utilized as estimates of $F'_m \times 60$ and added to the calculated hourly values. The daily total then represented F in equation (4), the first approximation to the daily solar radiation falling on a horizontal surface during cloudless days; values of F were plotted on a map and smooth isolines were drawn, which made it possible to find F at any point in the United States.

All the factors in equation (3) have now been accounted for except the one involving D_m which is a factor including dust, reflection from the ground, and errors caused by the assumptions which entered into equation (3). No attempt has been made to estimate the diurnal variation of D_m. However, the daily value, D, can be estimated at places where solar radiation is observed; there is a group of stations for which daily totals of solar radiation are measured and the data since 1941 are readily available in the Monthly Weather Review. Prior to 1941, only the weekly means of daily totals were published, but the daily values were obtained from Weather Bureau files. However, these data are given without regard to the cloudiness condition during the day. In order to find D, there must be an estimate of Q, since $-D = Q - F$ (equation 4). Q was determined in the following manner:

As a pilot project, several years of radiation data for Washington, D. C., and Albuquerque, New Mexico were examined. The dates were listed for days during which no clouds had been observed at any of the regular hourly meteorological observations at these two stations, and the radiation data for those dates were obtained; these were, of course, the actually observed data for cloudless days, and they were plotted on a time chart similar to the one in Fig. 3. In addition, the radiation data for the same years were plotted for all days (cloudiness condition unknown) on which the observed radiation had been high. It was found that the annual curve drawn through cloudless-day data fell just below the very highest points. Using this fact, the highest observed radiation data for each of several years from each of 23 stations were plotted, and curves just below the highest values were drawn in each case. As an example, the data and curve for

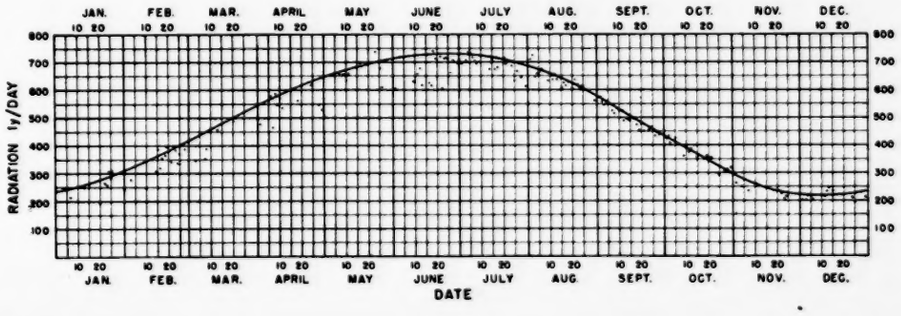


Fig. 3. Observed solar radiation received on a horizontal surface at Twin Falls, Idaho. The curve drawn just below the very highest points represents the average cloudless day radiation during 1932 at Twin Falls.

Twin Falls, Idaho, for 1932, are shown in Fig. 3. For each station, and for each year, the values for the 15th of each month were taken from the smoothed curves and averaged. The resulting average was then considered to be the average observed value, Q, for the particular station. It is obvious from equation (4) that the difference between Q and F would yield an average daily value for $-D$. From isolines of F previously calculated from the aerological data, values of F were interpolated at each radiation station.

The average values of $-D$, obtained by subtracting F from Q, were plotted on maps of the United States, and isolines of $-D$ were drawn. Because of the small number of radiation stations and their restricted geographical distribution there are many ways that these isolines could be drawn. In the first calculations, Madison and New Orleans were omitted for test, and it was found that if the extreme values of $-D$ were restricted to small geographic areas, the final values of Q at those test stations would be closer to the observed data. Consequently, the isolines of $-D$ were drawn so that the maximum and minimum values appeared as small areas. The values of $-D$ are included in Fig. 4, but the isolines have been omitted to avoid congestion.

From the isolines of $-D$, values of $-D$ were obtained and added algebraically to the computed value of F at each aerological station, to obtain Q. The final sums were then plotted on maps of the U. S. and appear in Fig. 4.

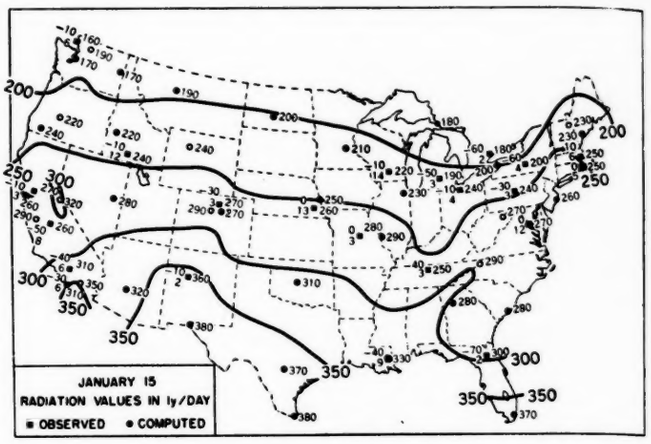
In several areas where the ground is markedly higher than the surrounding terrain, there are no aerological stations. For such large geographical areas, more or less at the same height, the calculations were carried through in the same manner as before. The pressures at the ground and the total precipitable water vapor above the ground at the elevated places were interpolated from upper-air data for the nearest aerological stations. The computations from these elevated regions were included in Fig. 4.

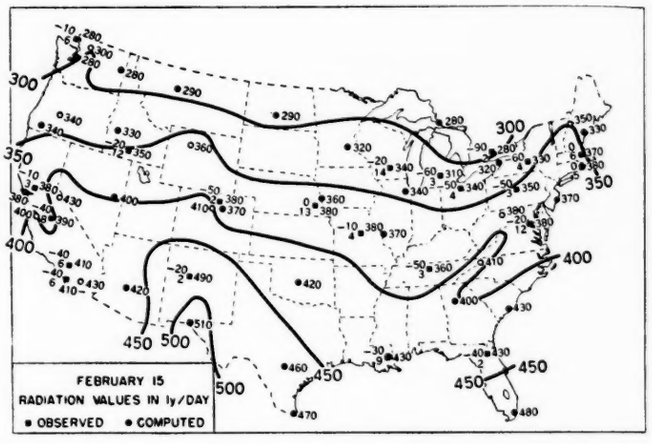
Obviously it would be impractical to compute the solar radiation for each point in the mountainous terrain, but the isolines in Fig. 4 have been drawn to account for the major changes of elevation. From the methods used to compute Q, effects of the albedo[3] of the ground and of atmospheric dust have been included, since by comparison of F with the observed data, these effects are included in D. However, where the albedo is markedly different from the places where solar radiation is observed as in places where snow cover persists for long periods of time or where the dust content is higher as in larger cities, the radiation would be different from the values shown in Fig. 4. For those places it would be necessary to make additional corrections.

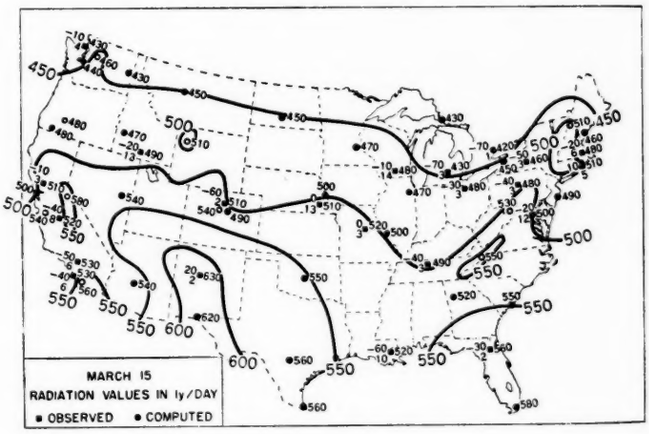
Discussion of Results

Since the albedo of the ground, especially when it is not snow-covered, would have only a very small

[3]The albedo of a body (such as the ground) is the ratio of solar energy reflected by the body to the solar energy incident upon it. For example, a freshly fallen snow cover will reflect about 90% of the solar energy which falls on it; the albedo of the snow cover is 0.90. Albedo of bare ground is generally about 0.10.







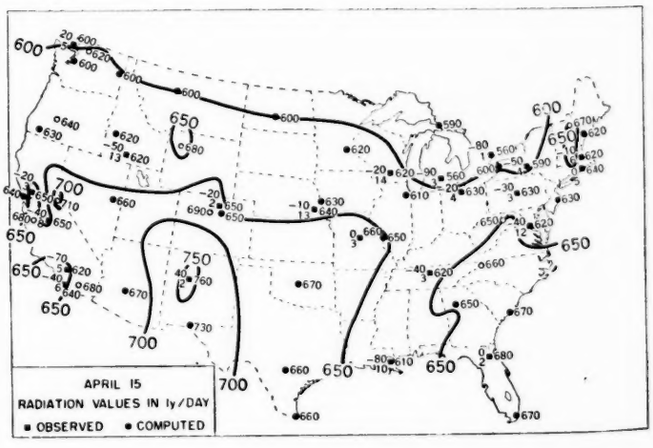
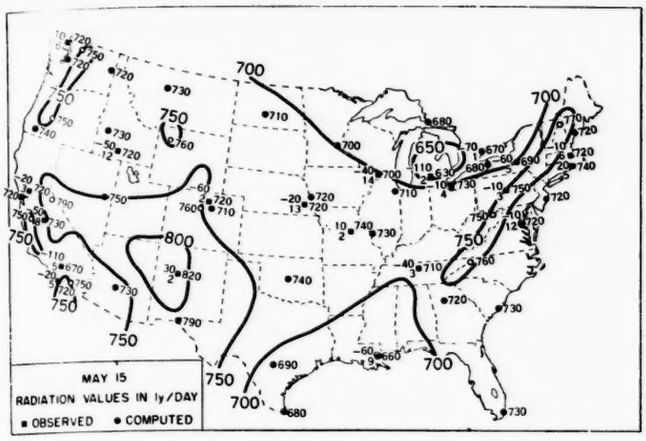
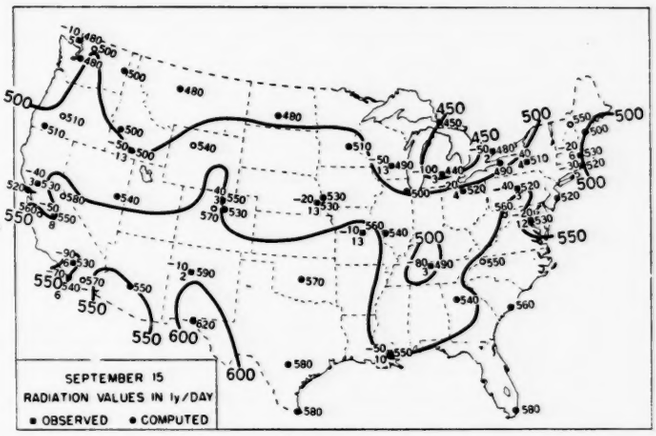
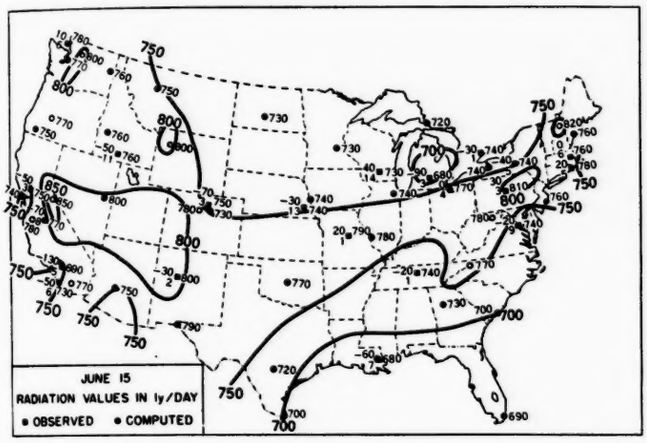
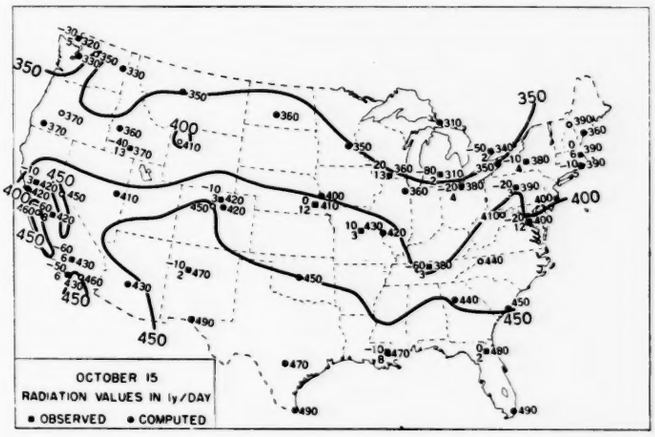


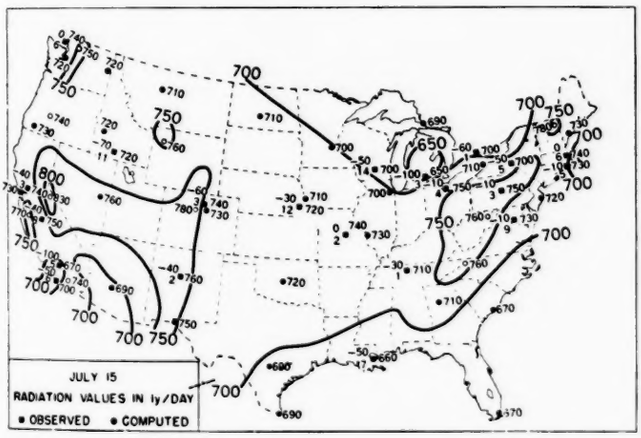
Fig. 4. Average solar radiation received on a square centimeter of horizontal surface at the ground on the 15th of each month during cloudless days (unit, ly per day). For the radiation stations (square dots on maps), the average

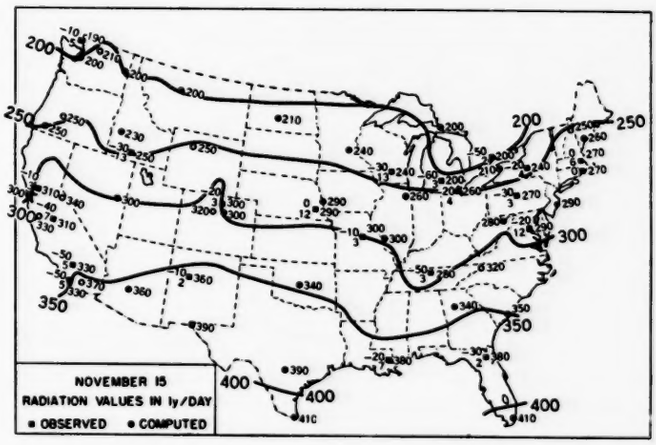


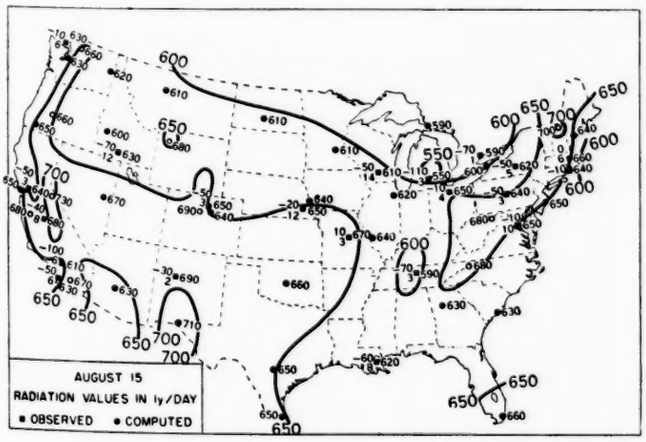


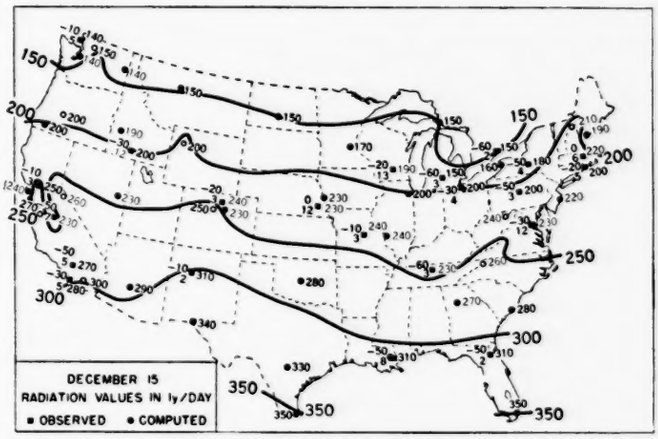












amount of solar radiation observed appears at the right of the station symbol, the "depletion" correction, $-D$, appears at the upper left, and the number of years of observation which were used appears at the lower left. For the aerological stations (round dots) only the final computed value for radiation is given.

effect upon the total radiation, it might be expected that the depletion of energy by suspensoids in the atmosphere would make the value Q always less than F, or that the quantity $-D$ would always have a negative value; and it is noted from Fig. 4, that in general this was found to be the case. However, there are cases when $-D$ has positive values, although they are small in magnitude; generally these occur in the central portion of the country. It is doubtful whether the positive values have any real significance (because of the errors inherent in the method of calculation) except to indicate that the absolute magnitude of $-D$ is small, which in turn must mean that the depletion of solar radiation in the center of the United States due to atmospheric pollution is small.

Other noteworthy features are the large negative values of $-D$ which occur in the Great Lakes region, in California, and often in the southeastern part of the country. Apparently haze along the coast and in the large valleys of California are effective in depleting as much as 10 to 15% of the radiation (F) which would reach the ground in a clean atmosphere. The data from Riverside indicates a depletion of 20%, although that may be a very local peculiarity, and perhaps nearby mountains do not give a totally free horizon to the pyrheliometer which measured the radiation.

In the Great Lakes region large negative values at East Lansing, Michigan, in particular, are persistent and marked, but nearly always the same effect, although less pronounced, is noted at adjacent radiation stations. Large industrial activity in the whole area, together with increased haziness caused by the Lakes, may be part of the reason for these depletions. It might be expected that similar reasoning could be applied to the New England area, but no such marked effect is found there. On the contrary, occasional positive values of $-D$, which are not readily explainable, are found in that region. The depletion in the Lake region is so large that, considering the small amount of radiation found there in winter, the depletion amounts to as much as 20 to 30% in that season; in summer it is about 10 to 15% of the radiation through a clean atmosphere.

The large negative values in the southeast are based for the most part on the data from New Orleans and Nashville. The New Orleans measurements have been made near the downtown area of the city, and although the Nashville measurements were made at the airport, the region near this smoky city may not be representative of the region as a whole. Near or in these cities, the depletion is often 10 to 20% of the clean atmosphere conditions.

With regard to the radiation isolines themselves, it is at once obvious that the latitudinal change of the amount of radiation which falls on the United States during a cloudless day is very marked in winter and very small in midsummer. In December, for example, central Texas receives about 350 ly per day while only about 135 ly per day, or less than half the Texas amount, falls along the northern boundary of the country. The longitudinal variation is affected somewhat by the height of the terrain, but is generally quite small. The predominance of the latitudinal change is, of course, due to the lower solar altitude and smaller number of hours of daylight in the north as compared to the south.

In the early summer months, the distribution is considerably changed. During these months, the cloudless day radiation is not much different in the Lake region from that in the Gulf States, a belt of maximum radiation extends east-west through the center of the country, and the elevation of the ground determines the location of the absolute maxima of radiation. This elevation effect should be anticipated from the fact that the greater number of hours of daylight in the north counterbalances the lower solar altitude there. Furthermore, when the amount of precipitable water vapor is large, changes in w affect the radiation relatively little, as shown in Fig. 2; therefore, although the south has more water vapor than the north, in summer when large amounts of vapor are present everywhere the difference does not affect the radiation distribution markedly. Therefore, in summer with many of the variables balanced between north and south, the radiation maxima are located more or less in the highest terrain.

A comparison between winter and summer radiation shows that, starting roughly with the same value everywhere in summer, namely about 750 ly per day, the radiation during cloudless days decreases in December to about 20% of the summer value in the north, and to about 50% of the summer value in the south.

Acknowledgment

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How to Evaluate Operating Characteristics of Suspended Unit Heaters

H. E. SMITH

Sales Engineer, Modine Manufacturing Company

Suspended propeller type unit heaters are accepted as standard equipment in the heating of commercial and industrial buildings. Perhaps because of this acceptance, there is a tendency on the part of engineers to select these unit heaters solely on the basis of heating capacity. The author has attempted to set up in simple form information by means of which performance characteristics other than heating capacity – such as outlet velocity, air volume, and noise–can be evaluated, with the objective of improving the quality of unit heater installations generally.

THE term "performance characteristics" as applied to unit heaters refers generally to Btu output; air volume in cubic feet per minute (cfm); outlet air temperature; outlet air velocity; electric power consumption, and operating noise level. For most installations it is extremely important that *no one of these characteristics be disregarded*—and there is no reason for their disregard since "ideal" conditions have been clearly and definitely established by exhaustive laboratory tests and by years of actual experience.

Although all of these operating characteristics are dependent on each other in that a change of one nearly always affects one or more of the others, they can best be discussed by being considered individually.

Heat Output

Nominal unit heater Btu per hour capacities are usually based on conditions with 2 pounds steam pressure and with 60F entering air. In the average comfort heating installation, unit heaters are selected whose total capacity in Btu per hour balances the heat loss of the room or building. An exception is made in the case of buildings or rooms heated intermittently; where quick pick-up is important, the total Btu capacity of the unit heaters should exceed the calculated heat loss requirement by from 25 to 50%.

When steam pressure other than 2 pounds is used, or when hot water is the heating medium, the Btu output of the unit will change and must be corrected in accordance with formulae and correction factors published in the manufacturer's catalog.

The Btu capacity of any unit heater will change with an increase or decrease in entering air temperatures. The amount of change can be determined by applying the manufacturer's correction factors.

Air Volume

Air volume (cfm) is possibly the next most important characteristic of a unit heater and yet it is most frequently disregarded in the selection of unit heating equipment. Although the desirable cfm delivery of any given unit can be precisely and easily determined, there is a wide discrepancy in the ratings of many manufacturers' products. It is therefore of the utmost importance that proper air volume be carefully considered by the heating system designer and made a part of the specifications.

With any unit heater, under any given set of operating conditions (steam pressure or water temperature and entering air temperature), an excess of air volume will increase the motor horsepower requirement and electric current costs and will reduce the temperature of the air coming from the heater to a point where the evaporative cooling effect of the moving air stream may be objectionable. In other words, the heated air stream will actually feel uncomfortably cool and drafty to persons in the path of the air stream.

Conversely, when a unit heater does not deliver a sufficient volume of air, the unit can be cheapened by using a smaller motor but the final air temperature will be increased, making the air uncomfortably warm to persons close to the unit. The heated air will be extremely buoyant, tending to bounce directly to the ceiling, resulting in stratification and wasteful overheating. Furthermore, the heated air stream cannot be projected or thrown a sufficient distance. Many of the inherent advantages of unit heating are thereby lost.

Final Air Temperature

As can be seen from the foregoing statements, the final air temperature of any given unit will vary in-

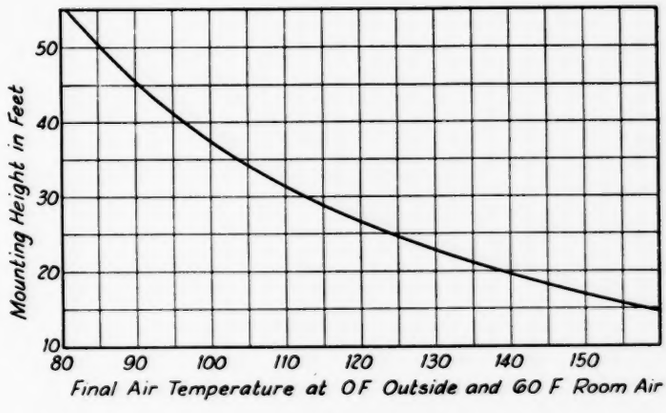


Fig. 1. Effect in variation of final air temperature on maximum mounting height of typical vertical delivery unit heater.

versely with the cfm. Since the desirable final air temperature is the same regardless of the size of the unit, it will obviously be easier for the heating system designer to use final air temperature rather than cfm as a yardstick in the selection of unit heaters.

Hundreds of laboratory tests and thousands of actual installations have proven that the final air temperature of any unit heater used for comfort heating should (for the room temperatures normally maintained) be from 50 to 60F higher than the design room temperatures. With room air (entering air) at 60F, the final air temperature should be from 110 to 120F, and with room air at 70F, the final air should be from 120 to 130F. If those figures are used in the selection of unit heaters, the cfm figures will automatically be correct.

The final air temperature of any unit heater will increase drastically with an increase of steam pressure (temperature) or an increase in entering air temperature and vice versa. Therefore, a unit heater having good final air temperature characteristics with steam at 2 lb pressure will deliver heated air at excessively high temperatures if supplied with high pressure steam, while the air would be too cool if hot water at, say, 180F is used as the heating medium. Since the catalog ratings of unit heaters are usually on the basis of 2 lb steam and 60F entering air, it is possible to set up rules of thumb for the simplified selection of unit heaters:

(1) *Low pressure steam (0 to 25 psi).* The final air temperature at 2 lb and 60F should be between 110 and 120F;

(2) *High pressure steam (30 to 125 psi).* The final air temperature at 2 lb and 60F should be from 95 to 105F; and

(3) *Hot water systems (170 to 210F).* The cataloged final air temperature with 2 lb steam and 60F entering air should be from 120 to 142F.

A more specific method of determining proper air volume in cfm in order to select the proper unit heater for a given job is to use the formula:

$$CFM = \frac{460 + E}{576} \times \frac{Btu}{55}$$

where CFM = required volume of air in cubic feet per minute,

E = entering air temperature in degrees (temperature to which room will be heated),

Btu = required Btu per hour output of unit heater at job condition of steam pressure or water temperature and entering air temperature, and

55 = desired temperature rise of heated air above E.

If units are to be selected by the use of this formula, a variation of 10% in cfm is acceptable, because the final air temperature will still be within the desired limits. This formula is exactly correct only for blow through type units but it can be used with acceptable accuracy for draw through unit heaters.

In discussing the importance of proper cfm and final air temperature characteristics in unit heater selection, it has already been pointed out that an excessively high final air temperature (insufficient cfm) will drastically affect the ability of a unit heater to project or throw the heated air a desirable distance. This is particularly important with vertical delivery units which will invariably be unsatisfactory if they cannot throw the heated air stream all the way down to the breathing line. Fig. 1 graphically illustrates the effect of varying final air temperatures on the maximum mounting height of a typical vertical delivery unit heater.

This chart (Fig. 1) will indicate that higher than normal cfm air delivery and low final air temperatures may sometimes be desirable when vertical delivery units are mounted at unusually great distances above the floor. In those cases the increased power cost will be justified and the low final air temperatures will not be objectionable because the discharged air stream will be greatly diffused and softened by the time it reaches the breathing line.

Face Air Velocity

Face air velocity usually expressed in feet per minute (fpm), representing the velocity of the heated air at the outlet face of a unit heater is fully as important as cfm and final air temperature in determining the desirable operating characteristics of a unit heater. Fpm may be described as representing the push given to the heated air to obtain the desired heat throw and to prevent stratification by thoroughly mixing the heated air with the room air.

The desirable fpm will not be constant with unit heaters of different sizes and Btu and cfm capacities. Very small unit heaters are used to heat small areas so that the air does not have to be "pushed" as hard as would the air from a large unit used to heat a large space. A too-high velocity from a small unit will probably cause objectionable drafts while a too-low velocity in a large unit will probably result in failure to blanket the entire area with heated air.

Vertical delivery units have to push the heated air straight down, directly opposite to its natural tendency to rise, and so the velocity (fpm) of a vertical delivery unit logically should be higher than for a horizontal delivery unit. Then, too, higher velocities are more acceptable in verticals than in horizontals because, in low ceilinged rooms, the velocity of the moving air at the breathing line can easily be softened by an efficient air diffuser. Such diffusers are offered by a few manufacturers as standard equipment and by most others as optional extras. Because it is impossible accurately to predict actual job operating conditions, vertical delivery unit heaters should be equipped with efficient, well designed, adjustable air diffusers.

The desirable range of air velocities in fpm for horizontal and vertical delivery unit heaters of varying cfm capacities is graphically shown in the chart,

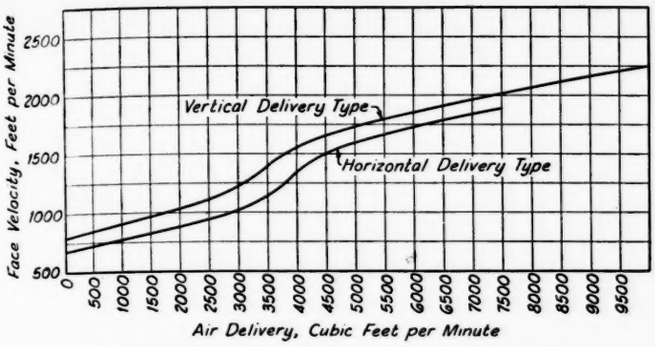


Fig. 2. Desirable face velocities for one company's line of unit heaters of various cfm capacities.

Fig. 2. A maximum variation of 10% should be permissible.

Power Consumption

If the cfm and fpm of a unit heater are not excessive on the basis already discussed, the electric power consumption will not be excessive, providing that an efficient motor is used and providing that efficiently designed fans and venturi type fan shrouds are a part of the unit heater design.

Shaded pole motors are acceptable and are customarily used only on very small units where power consumption is negligible but they should never be permitted on units requiring 1/20 horsepower or larger motors (units rated at more than 45,000 Btu with 2 lb steam and 60F entering air or units delivering more than 180 equivalent direct radiation or 725 cfm). Split phase, capacitor or polyphase motors should always be used on these larger units because they will require only about half as much electric current as the less efficient shaded pole motors. While these higher quality motors are more expensive the savings in electricity will, within a year or two, offset their higher cost on any heating job. The engineer should always specify the type of motor to be used.

Noise

Although a certain amount of operating noise is unavoidable in any fan-driven unit heater, it should always be kept to a minimum. On many jobs, such as offices, lobbies, showrooms, most commercial buildings and many light manufacturing buildings, noise is of primary importance in the selection of unit heaters. The sound level must then be kept to the lowest possible peak consistent with proper cfm and fpm.

This will often dictate the investment in a larger number of small units instead of a few large units. It will often also indicate the desirability of using two-speed or variable-speed motors since they will be less noisy if they can be operated at reduced speeds when maximum heat delivery is not required.

Many manufacturers publish, as cataloged data, the sound ratings of their unit heaters in decibels. These decibel figures can be interpreted by the use of Table 1 in selecting unit heaters for any given job and the allowable decibel rating should be made a part of the specification.

Table 1 — Permissible Noise Levels in Various Room and Building Types

Type of Building or Room	Permissible Sound Level (decibels)
Apartments, classrooms, courtrooms, executive offices, hospitals, libraries, museums, residences	25 – 40
General offices, hotel dining rooms, recreation rooms, showrooms, small stores, tea rooms, upper floors of department stores	41 – 50
Bank lobbies, cafeterias, drug stores, general offices, grocery stores, main floors of department stores, public buildings, post offices, restaurants, service stations	51 – 60
Factories, foundries, garages, machine shops, office machinery rooms, packing plants, shipping platforms, steel mills	61 – 75
Boiler works, forge shops, roundhouses, steel fabricating shops	76 – 80

In general, the noise of any unit heater will be minimized by good design and physical construction features such as a sufficiently heavy and rigid casing, solidly assembled; an efficient fan and fan venturi; an air straightening device to eliminate unequal velocities and unduly turbulent air; aerodynamically designed louvres or diffusers and a vibration-absorbing motor mount.

High speed motors (1750 rpm) are usually noisier than low speed (1140 rpm) motors but this is not an iron-clad rule since fan noise is largely a function of tip speed. In other words, a small diameter fan turned at 1750 rpm need not be noiser than a larger diameter fan turned at 1140 rpm. It is always true, however, that when one basic unit is offered with either 1140 or 1750 rpm motor (typical of many manufacturers), then the unit was designed for reasonably quiet operation at the lower speed and will be noisy at 1750 rpm. A safe rule to follow is "The fan speed of unit heaters larger than 200 equivalent direct radiation should never exceed 1140 rpm."

Conclusion

Because unit heater prices are generally based on Btu capacity, a quality unit heater costs no more to purchase than an inferior product. The unit heater which does not meet quality standards is a poor investment. It fails to provide the fine heating performance, fuel savings and low maintenance costs which a buyer should have the right to expect as a result of his purchase.

A typical unit heater rated at 100,000 Btu per hour represents an investment of not much more than $100, but for the average installation, the annual operating cost (fuel, maintenance, electric current) may total $190—almost double the initial cost.

Sound mechanical design and construction features plus good performance characteristics, correctly related to each other, are the guide-posts for unit heater selection. Use them to get full value for every dollar.

Adequate Dust Control for Foundries

B. F. POSTMAN
Industrial Hygiene Engineer

In this, the second part of a two-part article, the author discusses shake-out operations, core and sand removal, and suggestions for general housekeeping. Part 1 was published in the previous issue.

IN the smaller ferrous foundry handling small molds and pouring once a day, molders and helpers usually pour, dump and then are through for the day. A night man or crew may knock out cores, remove the castings to the cleaning or tumbling room, and condition the sand. In the larger foundry a night crew takes over the dumping, core knock-out, and sand conditioning operations.

No matter how intensive an educational campaign may be, workers operating under either of these two conditions mentioned will not wear any respiratory equipment.

What then is the answer to this problem?

Any attempt to provide general ventilation during the floor dumping operations will be prohibitive in cost because of the ventilation equipment required, and will not produce the anticipated results as far as definite dust control is concerned. The dominating factor is the height and arrangement of the roof structure. In any event, whether the roof be low or high, flat, sawtooth or monitor construction, comparatively large volumes of air must be handled to effectively flush out the building contents of its entrained dust. The exhaust air requirements are only half of the problem. The other half concerns itself with outdoor air supply during the winter heating season which must be tempered or heated before it enters the building. In this country, winter heating requirements may vary from 4 to 7 months of the year. It is for this reason alone that comparatively few large or small grey iron foundries handling small castings, provide any additional ventilation except the general ventilation the building structure contributes. This problem of foundry engineering economics resolves itself into one of cold cash, the expenditure of which must be added or prorated to every pound of finished casting produced in the plant.

For large or small floor areas, one solution is the utilization of sections of roll conveyors feeding one or more centralized shake-out stations which may be adequately hooded and mechanically exhausted. Capital expenditures for roll conveyor equipment will soon pay for itself in ease of mold handling, lessened back strains and hernias, improved management, better labor relations, considerable improvement in general foundry housekeeping, plant and machinery maintenance.

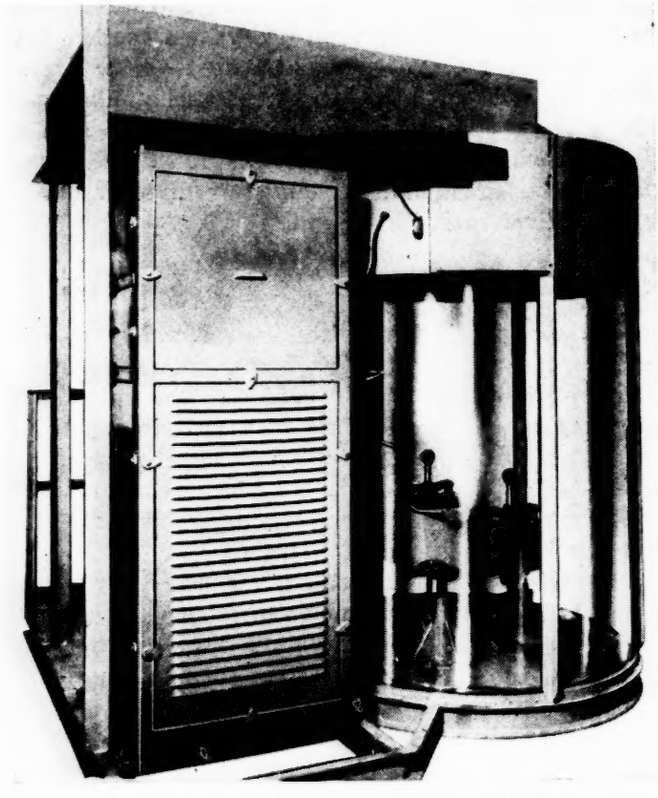


Fig. 8. Lintern Aire-Rectifier for crane cabs. When ambient temperature is 170F, temperature of air in cab is held to 85F.

Ferrous and Non-Ferrous Foundries

Dust control for the dumping of small molds in ferrous and non-ferrous foundries handling large and small molds, as usually performed in side-floor bays, is similar to that just discussed. Complications enter the problem when side-floor molding operations are on alternate or opposite sides or ends of the main foundry floor, separating ferrous or non-ferrous operations. If the dust control is seriously considered in this type of foundry unit, then all such dust dispersing areas must be controlled.

The most important, and by far the least attempted dust control problem due to the capital expenditures involved, presents itself when large molds are shaken out. Since the larger castings must set overnight or for a longer period of time, depending on weight or type of casting, shake-out of these castings may be done at any time during the working day. This results in dust dispersion throughout the entire foundry area, exposing all foundry personnel to varying concentrations of harmful dust. It is indeed very rare, if it exists at all, to see a large foundry which has been so constructed that a physical separation exists between the shake-out area and the foundry proper.

Many objections may be voiced, based principally on the erroneous assumption that dust control will interfere with crane operations. It should be clearly understood that if manufacturing or operating procedures are seriously interfered with, which may result in a

curtailment of production activities, then the contemplated control should not be considered, unless, no other method of attack presents itself.

It is not asking too much to isolate the large casting shake-out area preferably at one end of the main foundry floor or in a separate building and to provide a hinged split or sliding top deck, so that castings may be placed easily in or withdrawn from the enclosure. Some of the large blasting rooms and large spray booths are provided with this type deck for ease in handling large castings. The movable top deck may be operated by cables and electric motors. Size of the deck opening will be determined by the maximum size of flask being handled in the plant.

With the arrangement suggested, the operating procedure is simple. The crane operator picks up his flask, transports it to a point above the open top deck of the shake-out enclosure and lowers the flask. Operators, provided with approved dust respirators disengage the chains, which may or may not be lifted by the crane operator. Now that the flask is in place on a vibrating shake-out station, the crane operator may so manipulate the chain hoists as to remove the cope and intermediate flask sections. During this time, adequate general exhaust ventilation is provided for the shake-out enclosure. All air is required to enter the area left open by the movable roof deck. In this manner, the crane operator is protected against exposure to heat, gas and dust, while operators within the enclosure are guarded by respirators and the general ventilation provided for the enclosure.

Until shake-out operations start, or slightly previous to it, all operators should leave the ventilated enclosure and remain out until shake-out operations are completed. General ventilation is provided since the flask dismantling has been started and it should be continued for 3 to 5 minutes after shake-out has been completed, to purge the enclosure of most of the fine dust resulting from the shake-out. It is then, and not until then, that operators enter the enclosure, attach the chains for further handling by the crane operator and the casting is removed for further processing.

While some foundries require crane operators to wear approved dust respirators, this is not the solution to the problem and does not reduce exposure to heat and carbon monoxide.

About 10 years ago when the writer was making a survey of all foundries in Connecticut for the Bureau of Industrial Hygiene, State Department of Health, a sketch was developed for a glass-enclosed, ventilated crane cab. This sketch was presented to and discussed with superintendents of the larger foundries where many cranes were being operated. The general response to this suggestion for the protection of crane operators was in the negative. Nevertheless, that dream has become a reality. Today one organization manufactures glass-enclosed crane cabs, Fig. 8, and equipment for maintaining normal air and temperature conditions in foundry and steel mill crane cabs. Their Aire-Rectifier is capable of maintaining a properly designed and insulated crane cab up to 200 cu ft capacity, at 85F with an ambient temperature as high as 170F. Activated carbon filters remove noxious gases, and electrostatic filters take out oil vapors, smoke and toxic dust from the air supply to the cab.

While at present the cost for this equipment may appear high, future refinements in design and greater

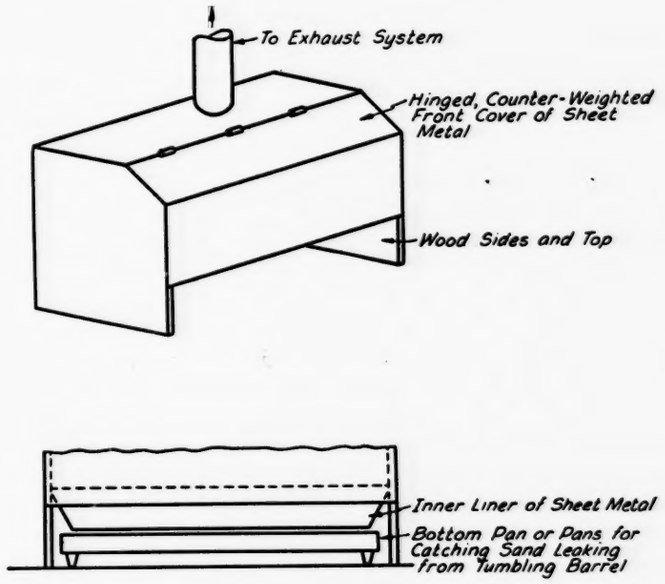

To Exhaust System
Hinged, Counter-Weighted Front Cover of Sheet Metal
Wood Sides and Top
Inner Liner of Sheet Metal
Bottom Pan or Pans for Catching Sand Leaking from Tumbling Barrel

Fig. 9. Enclosure for solid trunnion tumbling barrels.

adaptability will no doubt reduce these costs. One serious accident resulting from a crane operator's incoordination, due to bad atmospheric conditions in the zone of the craneway, may be more costly than installation of the conditioning equipment for the crane cab. More thought should be given to utilization of this type of equipment.

Air for Shake-Out Operations

For centralized shake-out stations which are fairly well enclosed, a minimum velocity of 200 to 250 fpm will be required for each square foot of enclosure opening. Under these circumstances practically no dust will be dispersed from the enclosure.

Where shake-out is performed on a vibrating grate or screen, with air movement across the grate and to a partial baffle or enclosure at one side or end, the air quantities should be prorated on a basis of minimum velocity of 400 fpm for each square foot of grate area. The effectiveness of side or end shake-out exhaust stations may be improved by increasing the top overhang and side extensions or panels to the existing shake-out grate, thus practically forming an enclosure with the front open. Due to interference from crane chain hoists and casting movement, all top and side panels may be pulled into position by a hinge and cable arrangement or by electric motors and cables as suggested for the movable top deck of the proposed shake-out enclosure. All that will be required is for the operator to press a button and the panels will slide forward or be retracted when shake-out has been completed. The time factor involved for this operation will be more than compensated for, when balanced against the time required and cost involved in cleaning the foundry structure and equipment resulting from dust dispersion from non-ventilated shake-out stations.

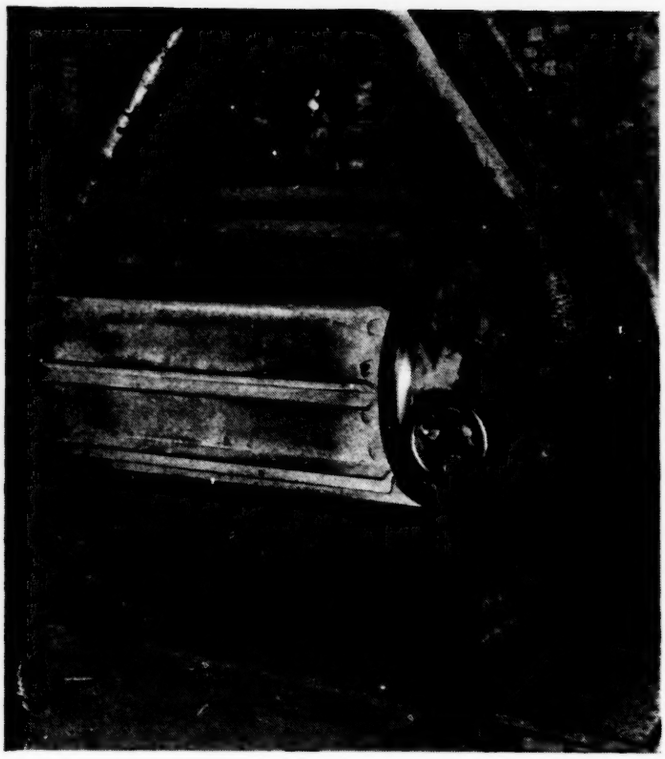


Fig. 10. Old type tumbling barrel with ventilation from both ends.

For the proposed shake-out enclosure with the sliding top deck, air quantities should be based on a minimum of 250 fpm prorated on the cross-sectional area of the opening located in the direction of the air flow. It is understood that all air entering the enclosure will come through the opening left by the sliding deck.

The large air quantities handled when large castings are shaken out need not scare the foundry industry, as this type of operation is not as continuous as it may be for the smaller castings or molds. This reduces the heat problem during the winter, which problem may be entirely eliminated if outdoor air is drawn into the enclosure instead of taking air from the foundry proper. All these factors should be considered in the basic design.

Ventilated down-draft shake-out grates have not proven effective in the foundry industry. Air travel is downward, theoretically at least, though most of it sweeps in from along the floor, practically at right angles to the normal upward travel of steam, dust and heated air currents and entrained air from the surrounding area. Not much can be said about this type of dust control. Installations have been costly, have proven ineffective, and have soured the foundrymen to the extent that uncontrolled shake-out of large castings is thought to be a necessary evil in the industry, because it cannot be economically controlled. This is not entirely true. Due to the variability of shake-out operations and the cost involved, very little study has actually been given to this most important phase of foundry technique.

Consider the small or medium-sized foundry where practically all floor molding operations constitute the main production. The physical layout of the foundry, production, tonnage and resulting costs and the usual lack of liquid capital definitely eliminate any consideration of even partial mechanization of shake-out operations as a means of reducing this excessive dust dispersion. However, much can be done through a coordinated housekeeping program in which the top management, foundry superintendent and foreman are interested. The steps of this program follow:

(1) Develop a coordinated housekeeping program for all foundry areas to include removal of all dust deposits from building structures, dust deposits from wall cabinets, core racks, and sills, together with the removal of unnecessary piles of unused sand which normally accumulate — particularly in the smaller foundry unit.

(2) Remove the many often unnecessary wall cabinets.

(3) Make a serious study, if necessary, of the possible re-arrangement of large flask storage within the foundry proper. It has been found that foundries in general rarely have adequate facilities for large flask storage. Pattern and core storage facilities seem to satisfy many foundry operators.

(4) Remove dust deposits, broken cores, excess or rarely used tools and general debris from the usual molding areas.

(5) Provide a thorough and well supervised wetting-down program, periodically performed during the shift, particularly for heavy traffic areas which normally produce excessive dust dispersion.

(6) Provide a personalized and continuously supervised program covering the use of respirators, approved by the U. S. Bureau of Mines, for all foundry personnel engaged in shake-out operations and core knock-out operations. This phase of the program is the most difficult to inaugurate, receives a minimum of cooperation from foundry personnel, and is usually the first suggestion dropped from any dust control program.

(7) Install an adequate number of wall and roof exhaust fans to provide general ventilation only during heavy dust-producing operations within the foundry, to aid in providing air movement during the summer months as a means of reducing heat zones, or for the removal of smoke and heat produced during pouring operations. Depending on the size of the foundry, exhaust air quantities may be based on an air change once every three minutes. This air quantity is not excessive when it is considered that the fan equipment will only be in operation for comparatively short periods of time. Enlightened, progressive and interested foundry management can pave the way to the general improvement of foundry operations which produce heavy concentrations of silicious dust—operations which previously were considered necessary and unavoidable conditions of the trade.

(8) Develop a physical examination and X-ray program for all present foundry personnel which should also include a pre-placement examination for new foundry personnel. In no other manner may a constructive dust control program be initiated and proven effective unless medical and engineering control, coupled with managerial supervision, become an integrated phase of the foundry production line.

Even full compliance with the recommended procedures outlined will not eliminate the most important item in foundry technique, control of dust dispersion from shake-out operations at the source.

The small or medium size grey iron foundry where floor molding constitutes the major portion of production should seriously consider the installation of an automatic shake-out station. Price range for castings weighing between 2000 to 3000 lb is approximately $1,500 to $2,000. To this price must be added cost of dust control hoods or enclosures, piping, fan and collector. Capital investment for this type of important dust control will be amply repaid by: Time saved for shake-out operations; possible reduction in number of shake-out crew; improved working conditions during all seasons of the year, particularly for crane operators; reduced labor turn-over of shake-out crew; reduction in flask breakage or damage.

Core Removal

If uncontrolled, as now performed in many foundry units, core removal from medium and large castings may justifiably be placed next to the shake-out operation as far as dust dispersion and exposure are concerned.

Because of the dust dispersed from dried cores, operators should be discouraged from the use of a hammer to remove cores from small castings or hitting two small castings together to perform the same operation, without the use of a respirator. Such operations should be performed within a ventilated enclosure.

While dust dispersion created from handling cores from a small casting may seem trivial, nevertheless when this operation is performed daily with hundreds or thousands of small castings, then the dust exposure to foundry personnel becomes a serious problem. A tired molder or a shake-out crew man will not always wear a respirator. Some foundries have discharged personnel for not wearing respirators, but this procedure is not recommended as it is not the answer to a simple dust control problem.

The extent of the core removal problem depends in large measure on the size and type of casting being processed. Hydraulic equipment is available today to remove cores from small and medium sized ferrous and non-ferrous castings. Two manufacturers provide hydraulic core knock-out equipment which has become a boon to the foundry processing large castings on a production basis. These installations are not too costly—the reduced operating costs are indeed astonishing.

The tremendous advance in general foundry technique during the past 10 years has been due to the reduction in man hours for core knock-out operations, decrease in machine shop operations due to the complete removal of sand adhering to the surface of the castings, and complete control of silicious dust dispersion from this operation.

The work is tedious, heavy and in many instances hot. If this operation must be performed with air operated tools, then it should be in a ventilated enclosure where a minimum air velocity of 200 fpm is maintained.

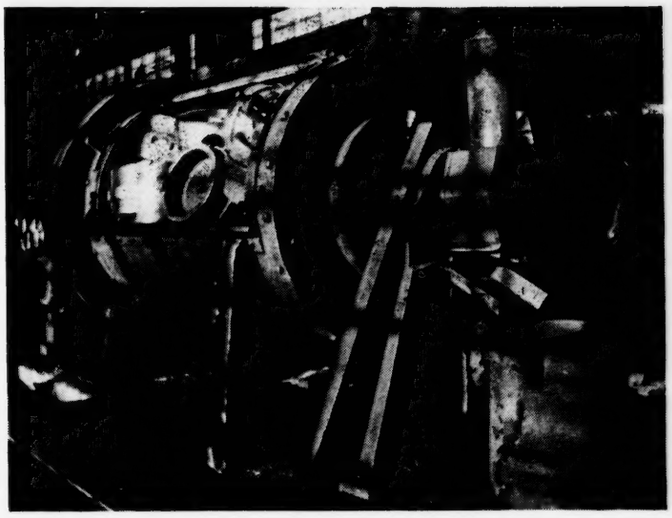


Fig. 11. Modern tumbling barrel installation. Effective ventilation is provided from one end.

The usual procedure for large core knock-out operations is to have the castings transported to one end of the foundry, or have them left where they were shaken out the previous night, and then have the workers attack the cores with crowbars or pneumatic tools.

Rough Sand Removal

The problem of removing rough sand from small castings previous to tumbling should not be lightly dismissed. Effective hydraulic cleaning of castings with resulting core removal will materially aid in reducing or entirely eliminating dust exposure to sprue cutter and band saw operators where non-ferrous castings are handled.

When hand or mechanically operated wire brushes are used for rough sand removal, this operation should be performed in front of a small hood provided with adequate exhaust ventilation based on a minimum velocity of 200 fpm across the front of the hood opening. The standard narrow hood over a wire brush wheel will not be successful in materially reducing dust exposure to the operator. The lateral carry-off of the dust and metal parts due to the casting being moved from side to side will not be influenced by the usual inadequate suction applied to the rear of the hood. A well-ventilated enclosure should be used for this operation.

Acid pickling for removal of rough sand from surfaces of ferrous and non-ferrous castings is still used to some extent. General ventilation is required near the pickling tank. Acid vapors are decidedly destructive to all types of exhaust equipment and sheet metal ducts. Non-ferrous fan wheels, fully enclosed motors, wood or transite ducts are recommended. All exposed surfaces should be coated with bitumastic or similar material to resist the corrosive action of the acid vapors.

Casting Chipping

Chippers usually handle clean castings and the resulting exposure is primarily from metal dust. If chippers are required to work on castings with adhering

Fig. 12. Bartlett-Snow enclosing type dust sucker showing manual dumping of molds onto shake-out.

sand, these castings may be cleaned with water so that the chippers' exposure to silicious dust is materially reduced. It cannot be recommended that chippers be required to wear dust respirators daily for eight hours as may be practiced in some plants. This is an example of unintelligent application of a proper dust protection device.

In general, chippers, grinders, welders and core makers, should be isolated from the usual foundry operations thereby removing them from unnecessary contributory silicious dust exposures.

Tumbling Barrels

Tumbling barrels are another source of dust generation and dispersion. Solid trunnion barrels usually have loose-fitting warped covers or staves which allow considerable quantities of fine silicious and metallic dust to be disseminated to the general plant area. This type equipment is becoming obsolete and when worn out is usually replaced with hollow-trunnion ventilated barrels or modern ventilated blasting equipment.

Control for solid-trunnion barrels is to provide a wooden enclosure about individual unit or group of barrels, Fig. 9. These enclosures are provided with counterweighted hinged front covers which may be raised when the barrel is filled or emptied. Depending on the length of the barrel, usually one or at most two exhaust connections should be provided at the top of the enclosure. A metal pan on wheels should be located under each barrel to catch most of the dust which normally drops out of the barrel and falls to the floor. The wheels allow the pan to be removed easily by the operator, preventing back strains and hernias, thereby allowing the dust to be shoveled into a wheelbarrow or other container for later removal. In any event, approved dust respirators should be provided for operators who work with solid-trunnion or inadequately exhausted barrels.

Ventilated tumbling barrels may be of two types, one having a 2 or 2½ in. dia connection at each trunnion, Fig. 10, and the other, the most modern type, Fig. 11, with a minimum of 4 in. dia connection at one trunnion only. The first type theoretically receives its air supply through a large number of small holes in the shell of the barrel, which holes also allow considerable dust to drop to the floor. The second type receives its air supply through the trunnion opposite to the one connected to the exhaust system. Air distribution within the barrel itself is obtained by means of a perforated circular plate set some distance away from the air-inlet trunnion.

Abrasive Blasting Equipment

The most modern abrasive blasting equipment use shot, steel grit, sand, or a combination of these, as the abrasive. All modern blasting units are provided with adequate exhaust applied at internal points of dust generation. Aside from occasional leaky rubber gaskets, this type of equipment presents no serious dust exposure.

Modern ventilated blasting rooms sometimes become leaky due to faulty maintenance.

Blasting helmets should be periodically checked for leaks, especially about the shoulder sections of some types, where the material tends to crease and eventually crack. At all times, clean filtered air, with all oil odors removed should be supplied to each helmet at the rate of from 4 to 6 cfm. The most modern equipment is a separate low-pressure blower, obtaining its air supply from an outdoor non-dusty source. In this manner, oil fumes, or the possibility of carbon monoxide asphyxiation from leaky compressor valves, may be avoided.

Other abrasive blasting equipment such as cabinets and tables should be inspected for dust leaks. Sleeves on cabinets are usually torn or entirely missing. The split rubber aprons on blasting tables are often missing in places.

Maintenance Crews and Other Foundry Personnel

It is indeed a difficult matter to demand that maintenance crews wear respirators while doing repair or new installation work in foundries. Unless an emergency exists which requires immediate attention, all such work should preferably be done after working hours, when dust exposure is reduced to a minimum. Night shake-out operations may aggravate their dust exposure. Regular foundry laborers should be provided with and taught the necessity of using a dust respirator. It should be hung about their necks and used as necessity demands.

General Housekeeping

There seems to be an aversion to keeping work areas and gangways well wetted down due to the possibility of metal splash. Surely, no one is interested in mud areas or pools of water on work areas or gangways. Dirt work areas and gangways can be kept well moistened (4 to 7% moisture content) similar to that of molding sand.

In some ferrous foundries, the area about the cupola is effectively wet down a short time previous to pouring and no accidents have occurred. One ferrous foundry unit allows about ½ in. of sand to accumulate on all concrete gangways. Ordinary fuel oil is sprayed

on these gangways twice a week, Wednesday and Saturday, by a tree sprayer held close to the gangway. In this way the fine mist penetrates through the sand accumulation and into the concrete. Results have been very successful and no explosions have resulted. Concrete need only be moistened but not dampened. Proper operator technique is necessary for this differentiation. Everyone knows that concrete is porous and many serious explosions have occurred due to hot metal coming in contact with excessively wet concrete surfaces. Three causes are responsible for this. (1) Someone is decidedly negligent in supervising the wetting-down procedure. Concrete need not be wetted but it can be kept clean. (2) There is usually too much rush during pouring operations. (3) Too much metal is carried in hand ladels. Metal spillage is a foregone conclusion.

Use of industrial vacuum cleaning equipment is increasing in the foundry industry. Even the smallest type of vacuum cleaner is costly and foundries in general are hesitant to invest in this equipment, when other more essential foundry equipment is needed. There is no better way to clean beams, girders, trusses, sills and work areas, than by the use of a vacuum cleaner. Hand brushing is used in some foundries. Compressed air is not recommended, for this costly procedure only displaces the dust from one resting place to many others in the foundry. Water is a cheap method of cleaning, but where much machinery is present, the effectiveness of the method is questionable. Tarpaulins, treated for protection against mildew may be used to cover foundry equipment. Then the hose may be used with excellent results. However, if dust dispersion as mentioned in previous sections is controlled at its source, plant clean-up problems will be reduced to a minimum.

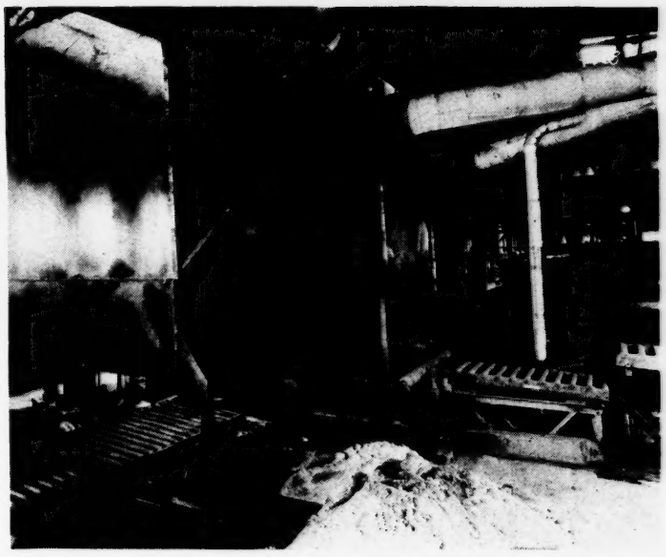


Fig. 13. Bartlett-Snow special enclosing type dust sucker with mechanical shake-out for side entrance of flasks.

Effective dust control in all foundries will reduce maintenance and housekeeping problems throughout the industry. However, the primary function is the reduction of the exposure of all foundry personnel to silicious dust resulting from uncontrolled dust dispersion.

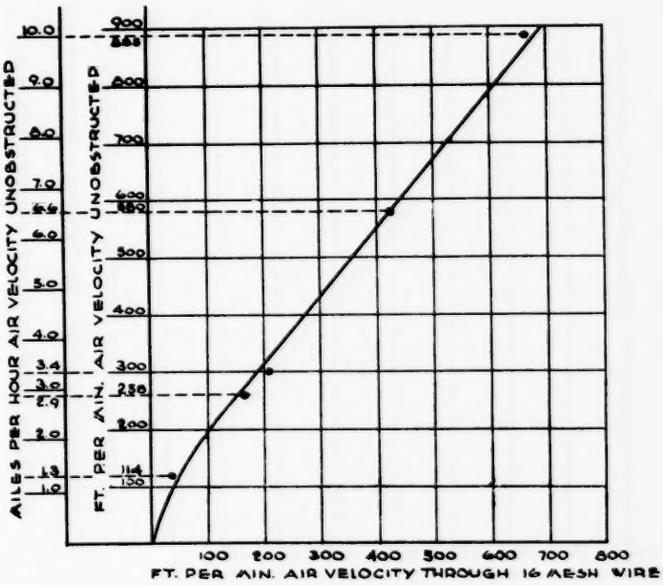
Effect of Wire Screen on Air Flow

As usually installed in attic gables or eaves, louvers are screened with 16-mesh wire cloth to keep out birds, insects, and rodents. To determine the effect of such screens on the amount of air that flows through these ventilators, tests were made at various air velocities with 16-mesh common house screen. The tests were made at the Forest Products Laboratory of the U. S. Department of Agriculture.

In these tests, air was driven with a centrifugal blower unit against a velometer, which measured the rate of air flow. Velocity was varied by means of a butterfly damper on the blower. The effect of screens on air flow was measured by placing one 4 in. in front of the velometer. To be certain of correct air velocity for each rate, five velocity determinations were made without the screen and five with it in place.

Typical data obtained in these tests are given in the following tabulation and chart. These are average values based on five runs each. A velocity averaging 114 fpm is equivalent to a wind velocity of about 1.3 miles per hour, 258 ft to 2.9 mph, 300 ft to 3.4 mph, 580 ft to 6.6 mph, and 885 ft to about 10 mph.

Air velocity without screen, ft per min.	Air velocity with 16-mesh screen, ft per min.
114	36
258	156
300	208
580	419
885	668


MILES PER HOUR AIR VELOCITY UNOBSTRUCTED
FT. PER MIN. AIR VELOCITY UNOBSTRUCTED
FT. PER MIN. AIR VELOCITY THROUGH 16 MESH WIRE

Courtesy, HHFA Technical Bulletin

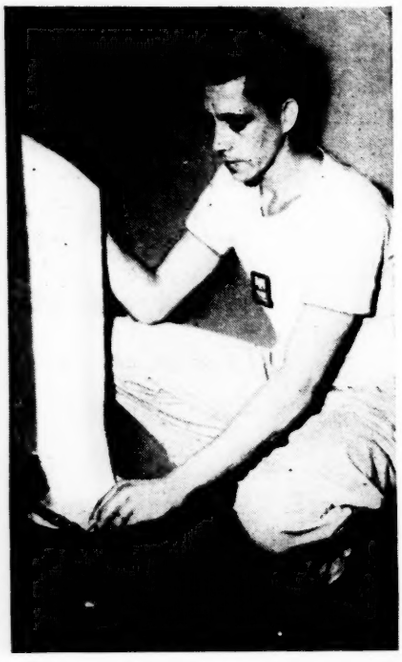
Chart showing effect of 16-mesh per inch insect screen in reducing air movement at various wind velocities.

A Material for INDUSTRY

Lagging Adhesive Eliminates Stitching

AS the result of development in the marine field, a rapid method is available for holding non-conducting material around pipe, ducts and boilers, without the necessity of sewing to keep the covering in place. Instead of stitching, a special adhesive is used.

This substance, Arabol 60-89-05, is supplied as a white semi-liquid which when thoroughly mixed has the consistency of a medium heavy paint. However, for most uses, the makers suggest that the adhesive be diluted in the ratio of one gallon of adhesive to one quart of water. In this form the resulting liquid looks like thin milk.



Lagging material is thoroughly saturated in the liquid, the excess solution is then partially wrung out, and the canvas is ready to be applied.

The adhesive may be applied by dipping the canvas lagging in the diluted mixture, or a brush coat may be given to cover the entire surface of the pipe insulation.

For straight pipe runs, a length of canvas is cut in a strip of the proper width to cover the pipe, including an overlap of 1½ to 2 in. The fabric is dipped into the diluted adhesive, partially wrung out to remove the excess liquid, and the lagging is placed in position on the pipe. After wrapping the lagging around the pipe, it is pulled taut. The material is then smoothed to eliminate any uneven portions. The adhesive, which sets in about 20 minutes and dries in from 4 to 6 hours, shrinks tight around the pipe covering to result in a smooth cover.

When applied by brushing, one method is to paint the undiluted substance to the entire surface of the pipe insulation before covering with the lagging. Another method is to paint a strip the length of the pipe at the point where the seam will be located. Canvas is placed in position and pressed to the insulation. The adhesive will hold the covering in position until the outer edge is brought around the pipe to the first edge. Before overlapping, adhesive is brushed on the seam. To complete this, a coat of diluted adhesive is brushed on the entire canvas lagging.

For turns and fittings, the adhesive is used undiluted either as a dipping mixture or by brushing. At such locations, taping is suggested for better-appearing results.

The adhesive when dry acts as a sizing so that where painting is desired, one coat of casein paint should prove sufficient. Arabol is said to be vermin-proof and fire retardant and suitable for use on canvas, asbestos, fiberglas or cork. Tests show that the adhesive when thoroughly dry is moisture resistant and that the bond will not be altered by exposure to extreme temperature, and immersion in steam or water. Therefore, it is claimed grease, soot and dirt wash off easily.

With this method, lagging can be applied by unskilled labor and at a rate much faster than if sewing were employed.

After wrapping around pipe covering or duct, material is smoothed out. When dry, it shrinks to form a firm cover.

Joints to Permit Movement

J. E. YORK

Building Service Engineer, Stone & Webster Engineering Corp.

Part 1 of a three-part article dealing with the type joints available to compensate for expansion or contraction of a pipe line. This provision for movement may be provided for in three ways. This article is part of an extensive series on Joints for Pipe.

WHILE most joints in piping systems are designed for stationary conditions, it is necessary in some cases to provide for movement which may be longitudinal, swinging or else rotational in character.

Longitudinal movement is the most common form of movement and is generally caused by the expansion and contraction of a pipe line due to changes in temperature.

Table 1 shows the increase in length per 100 ft of copper, wrought iron and steel pipe for temperature ranges between 0 and 1,200F.

Swing in pipe joints may in some cases be required because of expansion and contraction, as will be explained later, but in many cases it is required to permit flexibility in connections which must be made temporarily to equipment such as tank cars at a loading station. These tank cars may not always be spotted on exactly the same location or the pipe connections may not be arranged exactly alike, and when the unloading operation is complete, the connections may have to be swung to one side where they will be clear of the cars.

Rotational movement may be necessary to make it possible to provide a continuous supply of steam, hot or cold water, brine, etc., to equipment with rotating coils or cylinders.

Table 1 — Linear Expansion of Pipe*

(In Inches per 100 Ft)

Temp., F	Material			Temp., F	Material		
	Steel	Wrought Iron	Copper		Steel	Wrought Iron	Copper
0	0	0	0	390	3.156	3.291	4.532
10	0.075	0.078	0.111	400	3.245	3.383	4.653
20	0.149	0.156	0.222	410	3.334	3.476	4.777
30	0.224	0.235	0.333	420	3.423	3.569	4.899
40	0.299	0.313	0.444	430	3.513	3.662	5.023
50	0.374	0.391	0.556	440	3.603	3.756	5.145
60	0.449	0.470	0.668	450	3.695	3.850	5.269
70	0.525	0.549	0.780	460	3.785	3.945	5.394
80	0.601	0.629	0.893	470	3.874	4.040	5.519
90	0.678	0.709	1.006	480	3.962	4.135	5.643
100	0.755	0.791	1.119	490	4.055	4.231	5.767
110	0.831	0.871	1.233	500	4.148	4.327	5.892
120	0.909	0.952	1.346	520	4.334	4.520	6.144
130	0.987	1.003	1.460	540	4.524	4.715	6.396
140	1.066	1.115	1.575	560	4.714	4.911	6.650
150	1.145	1.198	1.690	580	4.903	5.109	6.905
160	1.224	1.281	1.805	600	5.096	5.309	7.160
170	1.304	1.364	1.919	620	5.291	5.510	7.417
180	1.384	1.447	2.035	640	5.486	5.713	7.677
190	1.464	1.532	2.152	660	5.583	5.917	7.938
200	1.545	1.616	2.268	680	5.882	6.122	8.197
210	1.626	1.701	2.384	700	6.083	6.351	8.460
220	1.708	1.786	2.501	720	6.284	6.539	8.722
230	1.791	1.871	2.618	740	6.488	6.749	8.988
240	1.872	1.957	2.736	760	6.692	6.961	9.252
250	1.955	2.044	2.854	780	6.899	7.175	9.519
260	2.038	2.130	2.971	800	7.102	7.384	9.783
270	2.132	2.218	3.089	820	7.318	7.607	10.056
280	2.207	2.305	3 208	840	7.529	7.825	10.327
290	2.291	2.393	3.327	860	7.741	8.045	10.598
300	2.376	2.481	3.446	880	7.956	8.266	10.872
310	2.460	2.570	3.565	900	8.172	8.489	11.144
320	2.547	2.659	3.685	920	8.389	8.713	11.420
330	2.632	2.748	3.805	940	8.608	8.939	11.696
340	2.718	2.838	3.926	960	8.830	9.167	11.973
350	2.805	2.927	4.050	980	9.052	9.396	12.253
360	2.892	3.017	4.167	1000	9.275	9.627	12.532
370	2.980	3.108	4.289	1100	10.042	10.804	13.950
380	3.069	3.199	4.411	1200	11.598	12.020	15.397

*From HEATING AND VENTILATING's Engineering Databook, by Clifford Strock, p. 3-57

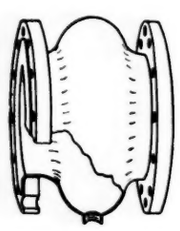
Unrestricted Corrugated Expansion Joints

Manufacturers of small turbines, engines and pumps, commonly specify that expansion joints must be provided on the exhaust outlet of their equipment for protection against strain due to the expansion of the piping.

As pressures for this type of service are usually low, the pipe expansion will be limited and low pressure copper expansion joints of the type shown in Fig. 1 may be used.

Joints of this make and type are restricted for use between 0 and 15 lb steam pressure and should not be used when the expansion to be taken care of exceeds ¼ in. They should never be used on vacuum

service because of the danger of collapsing the copper shell. They may be installed in either a horizontal or vertical position and should always be cold sprung ⅛ in. upon installation in order to relieve them of excessive strains when the line is put into service. The pipe lines containing them must be carefully anchored to force the joints to compensate for the expansion and contraction in the piping. The piping should be properly supported to relieve the expansion joints of the necessity of carrying any great weight.



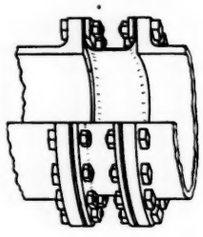


Fig. 1, left. Low pressure copper expansion joint. Fig. 2, right. Copper expansion joint for vacuum service.

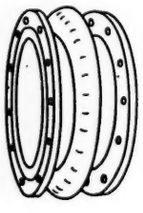
A copper expansion joint, Fig. 2, is for vacuum service and should not be used for other conditions.

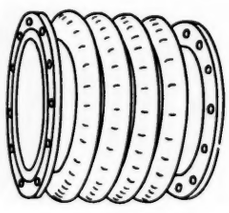
For pressures up to 25 lb per sq in. and expansion travel of not more than ½ in. a nonequalizing single corrugation expansion joint as shown in Fig. 3 will generally be satisfactory. With a single corrugation for travel up to ½ in., the force in pounds necessary to compress the joint may be calculated for copper by multiplying the inside diameter of the pipe in inches by 200; for joints using stainless steel corrugations, by multiplying the diameter by 300.

Fig. 4 shows a nonequalizing expansion joint of the same make with multiple corrugations. A multiple corrugation joint requires less force to compress than one with a single corrugation. It can also be used to absorb vibration and to correct any lateral displacement up to ⅛ in. per corrugation. The force required to compress multiple corrugation joints of this type may be calculated for copper by multiplying the inside diameter in inches by 100; for stainless steel by 150 times the diameter in inches.

The nonequalizing type of expansion joint can be furnished from 4 to 48 in. diameter with one to five corrugations. It can also be made oval, rectangular or in special shapes to order. The outside diameter of a round joint is about that of a flange of the corresponding pipe size. This is especially advantageous when the installation is in cramped quarters or in trenches or tunnels.

In process plants, such as oil refineries and for the chemical industry, the conditions under which expansion joints must operate may be more severe than in the more common types of installation. Oil refineries may require expansion joints in lines where the temperatures are high; chemical processing may produce extremely corrosive conditions, and diesel and gas engines produce corrosive exhausts at high temperatures.





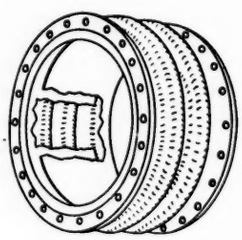


Fig. 3, left. Single corrugated expansion joint. Fig. 4, center. Nonequalizing expansion joint with multiple corrugations. Fig. 5, right. Expansion joint with an internal sleeve.

The use of monel metal sleeves is recommended with copper joints where superheat occurs.

In Fig. 5 is shown an expansion joint of this type with an internal sleeve.

For use with corrosive fumes joints may be lead lined.

One well-known manufacturer offers five types of corrugated expansion joints suitable for: Transmission of steam, oil, gas, diesel exhaust, acid and corrosive chemicals; pressures from vacuum to 1,000 lb per sq in.; temperatures ranging from —300 to plus 1,600F. All five types may be equipped with inner flow liners, if required.

These joints are designed and constructed to overcome the limitations of the conventional type of expansion joints illustrated in Fig. 1 to 5, inclusive, noted as follows:

(1) *Length.* Corrugated or one-piece bellows made of seamless or brazed tubing are limited as to the number of corrugations (usually not more than five) which may be furnished in a single joint because forming the tubing beyond this number of corrugations overworks the metal. This limits the amount of traverse available.

(2) *Life Cyclage and Oscillating Frequency.* In a one-piece bellows the depth of the corrugations and therefore the number of times the unit can be oscillated is limited. The limited span of flat surface in the corrugation requires that the metal must be extended beyond its elongation limits. In time failure or cracking due to crystallization will result.

(3) *Limited Choice of Metals.* In a one-piece bellows, the corrugating of the tube requires that the metal be either sufficiently ductile or frequently annealed during processing. Consequently, copper is quite generally used. This imposes further limitations on the choice of metals to overcome conditions of corrosion and excessive temperatures. What is more important is that it does not permit the use of tempered metals to provide adequate tensile strength for pressure conditions, and elasticity or spring quality for required movement without exceeding the elastic limits of the metal.

The joints shown in Fig. 6 to 10, inclusive, are designed not only to overcome these restrictions but also to provide several important advantages as given here:

(1) *Unlimited Length.* Regardless of the diameter of the bellows required, the length of the flange type bellows is limitless because of the built-up method of construction, which also gives equalized flexing without guide rings or bars.

(2) *Endurance and Long Life.* The construction used permits the bellows diaphragms to operate

like a cantilever spring. Since the joints are the anchor points, they do not move and so are not subject to the work hardening caused by the reverse bending necessary in the one-piece type of construction. The joints are made concentric and there are no cross seams in the deflecting members. In correct diaphragm design, sufficient slack is provided in the span portion of the bellows so that during flexure the joints are not subject to hinge action.

(3) *Wide Range of Metals.* A wide range of metals can be used in the construction of the diaphragm type bellows to overcome limitations relating to temperature conditions and corrosion factors.

Use of heat treated tempered metals for specialized applications insures, in addition to high tensile strength, a true spring action which also provides for lateral deflection without injury or permanent set.

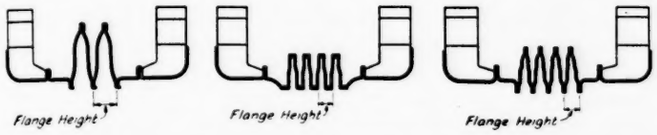


Fig. 6, left. Copper expansion joint with two diaphragms. Fig. 7, center. Monel expansion joint with four diaphragms. Fig. 8, right. Stainless steel expansion joint with four diaphragms.

While the diaphragm type of construction necessitates the closing of numerous joints, it does not impose any restrictions, due to the use of modern welding and controlled atmosphere brazing methods and the clinch lock seam construction.

Tests with pressures far beyond the operating limits have proved that failure occurs first by rupturing of the metal in the span section. There is no record of seam failure either under test conditions or actual field operation.

The first of these five types of corrugated expansion joints is the copper expansion joint with two diaphragms shown in Fig. 6. It has an operating pressure range from vacuum to 25 lb per sq in. and an operating temperature range from —100 to plus 300F. The expansion element is of all silver brazed copper construction. The maximum permissible longitudinal movement with two diaphragms is 2 in. but this can be increased by adding additional diaphragms. The allowable lateral deflection is ¼ in. per flange and the force required to compress this joint is 10 lb per sq in.

A monel expansion joint with four diaphragms of somewhat different design is shown in Fig. 7. This joint has an operating pressure range from vacuum to 55 lb per sq in. and an operating temperature range from —300 to plus 750F. The expansion element is of all silver brazed monel construction. The maximum permissible longitudinal movement (without adding diaphragms) is one inch and the allowable lateral deflection is ⅛ in. per flange. The force required to compress is 20 lb per sq in.

A stainless steel expansion joint with four diaphragms is shown in Fig. 8. This joint has an operating pressure range from 250 to 400 lb per sq in. with an operating temperature range from —100 to plus 1,600F. The expansion element is of hydrogen welded stainless steel construction. The maximum permissible longitudinal movement without additional diaphragm is one inch and the allowable lateral deflection is ⅛ in. per flange. The force required to compress is 30 lb per sq in.

Fig. 9, left. Stainless steel expansion joint for medium pressure range. Fig. 10, right. Stainless steel expansion joint for pressures from 600 to 1,000 lb per sq in.

A stainless steel expansion joint, Fig. 9, has four reverse bend diaphragms. This joint has an operating pressure range from 250 to 400 lb per sq in. with an operating temperature range from —100 to plus 1,600F. The expansion element is of all-heli-arc-welded stainless steel construction. The maximum permissible longitudinal movement without additional diaphragms is 1½ in. and the allowable lateral deflection is ⅛ in. per flange. The force required to compress this joint is 60 lb per sq in.

In Fig. 10 is shown another stainless steel expansion joint with five corrugations of special design. This joint has an operating pressure range from 600 to 1,000 lb per sq in. with an operating temperature range from —100 to plus 1,600F. The expansion element for this joint is also all-heli-arc-welded stainless steel construction and the maximum permissible longitudinal movement without additional diaphragms is 1½ in. The allowable lateral deflection is ⅛ in. per flange and the force required to compress this joint is 100 lb per sq in. All of the five expansion joints, Fig. 6 to Fig. 10, can be equipped with directional flow liners, if required.

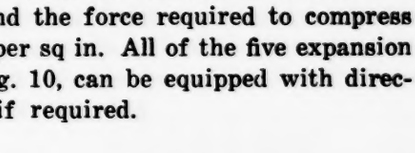


Fig. 11. Expansion joint for larger pipe sizes.

For larger pipe, sizes 14 in. to 72 in. diameter, the expansion joint shown in Fig. 11 can be furnished with a stainless steel, monel or copper expansion element having 8, 6, 4 or 2 bellows flanges with rated total movements of 8, 6, 4 and 2 in., respectively. The pressure ranges for these joints are 30 lb per sq in. with stainless steel, 20 lb per sq in. with monel and 10 lb per sq in. with copper elements. If required, they can be equipped with directional flow inner liners.

A double end expansion joint with a fixed anchor base, Fig. 12, can provide for unequal expansion or contraction by using an unequal number of bellows

flanges at each end. Other forms of this type of expansion joint are available.

In Fig. 13*a* is shown an offset joint for misalign-

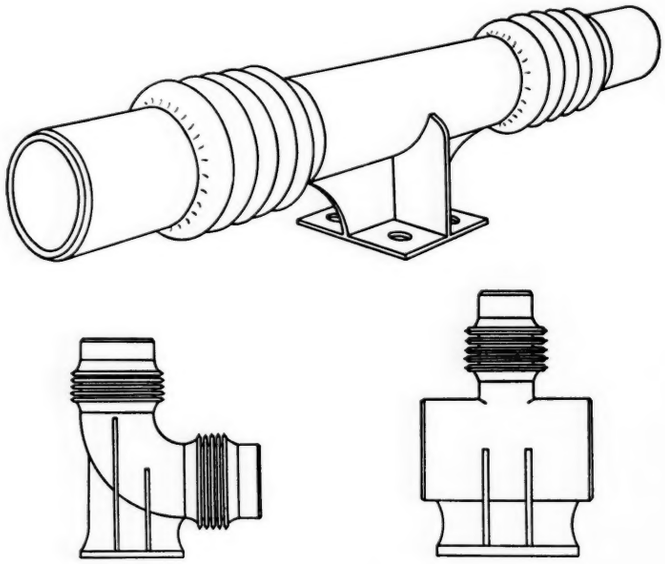


Fig. 12, upper. Double end expansion joint with a fixed anchor base. Lower, units with bellows and anchor bases.

ment correction. Misalignment may be of three distinct types.

(1) Lateral misalignment as shown in Fig. 13*b*. Standard joints of the type shown in Fig. 13*a* may be used when misalignment does not exceed 20 degrees. When the misalignment exceeds this amount, special recommendations should be obtained from the manufacturer. Approximately two degrees misalignment per bellows flange is permissible, but additional flanges must be provided to take care of the estimated expansion and contraction.

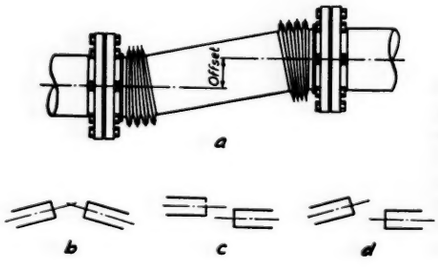


Fig. 13a. Offset joint for misalignment correction, (b) for lateral misalignment, (c) for parallel misalignment, (d) for angular misalignment.

(2) Parallel misalignment is shown in Fig. 13*c*. For this form of misalignment the number of bellows required for expansion and contraction is determined and the length computed accordingly. To this length, an additional 7 in. of straight pipe per ¼ in. offset must be added.

(3) Angular misalignment is shown in Fig. 13*d*. Where it is necessary to provide for this form of misalignment, recommendations should be obtained from the manufacturer.

A turbo joint, Fig. 14, is recommended for use where excessive pressures, abnormal temperatures and extensive movements are encountered, as in turbine headers where squirm and thrust must be completely neutralized. Pressures up to 1,000 lb per sq in. may be used with this type of expansion joint. To prevent squirming of this very elastic bellows, pressures are applied externally. Because the bellows are suspended in the direction of pressure and because of the contour of the bellows, the stresses are in tension, and the joint is not subject to distortion. This provides unusual resiliency under high pressures.

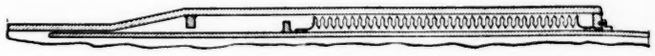


Fig. 14. Turbo joint for use where excessive temperature, pressures and movements are encountered.

To insure accurate installation, these joints are shipped with a removable retaining band which is placed in position at the factory at the precise installation length of the bellows at normal temperature. The joint should be installed in the same relaxed position, provided the ambient temperature of the line remains at approximately 70F or normal temperature. If, however, abnormal ambient temperatures are encountered at the time of installation, adjustment can be made to compensate for the variation in the ambient temperature so that the joint will operate normally throughout its entire temperature and pressure range. In all cases the retaining band should be removed after installation is completed and before the line is placed into operation. To assist in determining the position of the bellows at all times, a scale is provided showing the range of travel in contraction and expansion from free length.

Because the various tubular members of the expansion joint are located at varying distances from the

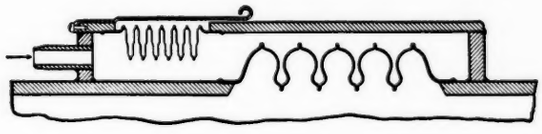


Fig. 15. Steam jacketed joint used for conducting viscous fluids.

flow mass, the temperature of these members will vary. An expanding type of piston ring is therefore installed to provide a flexible bearing surface to insure friction-free alignment and to prevent binding at the point of contact between the inner and outer sleeves.

A steam jacketed joint for conducting tar, asphalt or other viscous fluids is shown in Fig. 15. A secondary bellows is provided in the outer steam jacket.

Parts 2 and 3 of this article will cover rubber expansion joints, spool type joints, swing and swivel joints, and rotary pressure joints. This chapter on Joints to Permit Movement is the last of the series of articles on pipe joints that was started in the September, 1947 issue of HEATING AND VENTILATING.

Influence of Fuel Shortages on Heating Practice

NATHAN N. WOLPERT
Associate Editor, Heating and Ventilating

BECAUSE of the fuel shortages that existed during the past few years, with some sections of the country experiencing curtailment of more than one type of fuel, there has been a change in the thinking of heating engineers as regards fuels. These shortages of fuels have prompted many engineers to change the type of fuel they are now recommending for their clients and customers, and in some cases have even influenced current building design.

Just what is the favored fuel at present and how have fuel shortages influenced current practice as regards the heating of buildings?

To obtain answers to these and related questions, letters were sent to a thousand heating engineers in northern states. The following questions were asked:

1. Have the fuel shortages changed your usual practice as regards heating for buildings now being designed? Is so, in what way?
2. As compared with conditions one year ago, do you believe coal will show an increased use? Why?
3. Which fuel seems to have the best outlook for recommendation to your clients and customers?
4. From your experience, do you believe there is a need for a furnace or boiler capable of burning more than one type of fuel?

Influence of Shortages on Heating Practice

Of the replies received to Question 1, 68.7% reported that the fuel shortages did not change their practice as regards heating for buildings now being designed, and 31.3% stated that they did.

This is particularly interesting when compared with the results of a survey reported in the September, 1944 issue of HEATING AND VENTILATING. At that time in answer to a question on "Have the fuel shortages affected your plans for post-war buildings to the extent of changing your usual practices?" the replies were: 81% a flat "No," or with a slightly modified negative answer such as "Not Materially." An additional 5% answered somewhat less positively so that essentially 86% of the offices reported their plans unaffected. Of the other replies, 8½% gave a flat "Yes," and 5½% a qualified affirmative answer.

In the current survey, ten replies stated that the practice was influenced by an increased use of coal; 9 by an increased use of oil; 3 by an increased use of gas and 5 by a decreased use of gas.

Here are a few of the comments received to this question. Names of the engineers are withheld but the city is given so that the replies can be properly interpreted.

New York, N. Y.—The average small homeowner cannot afford to burn oil or gas with any great amount of economy. Oil is not consumed efficiently in the smaller units as most boilers are in a competitive class. In larger units the trend to oil was from a labor saving standpoint and not from economy, and the trend is to go back to coal with oil at its present price. With soft or buckwheat coal at $13.75 a ton, the equivalent amount of oil at 9½ cents per gallon is $16.75.

Joliet, Ill.—We are more careful to explain to clients regarding insulation and general tightening up of structures, the importance of keeping equipment clean, more zoning, and better firing methods. We are also more careful in the selection of equipment, that is, we are not in the habit of installing extra large equipment and we are trying to stay closer to actual requirements for better efficiency.

Grove City, Pa.—The fuel shortage affects the design of some of the smaller buildings on which we have worked. Since there is a critical shortage of natural gas during the winter months in this territory, we must use either coal or oil. The abundance of cheap coal in this area, however, determines its use on a job of any size.

Youngstown, Ohio — The greatest change in this area appears to be in domestic heating. There has been an appreciable swing towards gas heat. However, due to gas restrictions, not as many people are obtaining gas as would like to use this fuel.

Allentown, Pa.—For the past two years there has been a trend of conversion from oil to coal.

New York, N. Y.—Most of our business is heating 10 to 18 room houses with approximately 500 to 1,500 sq ft radiation. I am afraid to recommend oil due to the shortage. I always install gas. If the building has more than 1,500 sq ft radiation then, and only then, will I use oil. If the job is in a district where I cannot obtain gas, I use oil. Coal is never used if gas is obtainable.

Will More Coal be Used?

In answer to Question 2 concerning the possible increased use of coal as compared with the use of coal one year ago, 5.9% of the replies indicated that no increase was expected; 40.5% of those who replied believed an increase could be expected.

Again let us compare these returns with the 1944 survey previously mentioned. At that time the question was asked, "Do you look for increased use of stokers where formerly oil-burning equipment was specified?" The replies indicated that 46% did not

look for an increased use of stokers; 43% did look for such an increase; 11% of the replies were doubtful or unclassifiable. Of the 46% negative answers, 35% replied with a flat "No," and 11% qualified their comments. The 43% affirmative consisted of 30% that replied "Yes," and 13% modified.

Here are some of the interesting comments to Question 2 of this survey:

Rochester, N. Y.—Coal has always had the advantage over oil in this district. The increase in oil has largely been in residential and apartment properties and some mercantile property. In the downtown area, steam from a Rochester utility is extensively used. Coal will hold its own in this territory.

Canton, Ohio—One year ago, the oil situation was very bad and gas was nearly impossible to obtain, causing an almost exclusive recommendation of coal. Now the oil outlook seems improved considerably.

Kansas City, Mo.—Coal will never show an increase in this area for anything except industrial heating or power where natural gas or oil is not available.

Minneapolis, Minn.—With labor disputes fairly well settled, and with increased mechanization of the mines, coal should be cheaper than the other fuels and the supply should be more certain.

Fuel Recommended

Question 3 concerns the fuel which seems to have the best outlook for recommendation to clients and customers. Of the replies received, 44.8% were in favor of recommending oil; 29.3%, gas; 25.9%, coal.

Springfield, Mass.—When there is janitor service, we use coal; when there is no janitor service, we use oil.

Roanoke, Va.—Oil still seems to have the best outlook. Our customers seem to prefer oil to anything else. If oil were to become scarce, then the use of coal would boom.

Providence, R. I. — Some of our clients prefer to burn oil, even at a somewhat higher cost, since it eliminates the nuisance of coal storage, coal dust, fly-ash and ash removal.

Pendleton, Oreg.—At the present time in this area there is need for much curtailment of electricity. This eliminates any prospect for future electrical-heating of any type in the northwest for years to come. The present power shortage is due to become more acute.

Grove City, Pa.—We prefer to use natural gas on small installations and to use coal on larger jobs where the savings in the cost of fuel can pay for the labor of operation. Oil is eliminated as an economical fuel, and is used only when the other two are out of the picture.

Port Chester, N. Y.—Our clients are inclined to oil, due to its labor saving and also because of the present high price of coal.

Use of Two Fuels

Question 4, based on whether the readers believed there is at present a need for a furnace or boiler capable of burning more than one type of fuel, brought forth the following results; 75% saw the need for such a unit while 25% did not. This question prompted some interesting comments.

La Porte, Ind.—We definitely believe that there is a need for a furnace or a boiler capable of burning more than one type of fuel. This is particularly true for a boiler burning oil. We definitely believe that such a furnace should be capable of being changed over with the least amount of parts and labor to burning either gas or coal.

Fitchburg, Mass. — Most furnaces or boilers do a reasonably good job of conversion now, particularly on the large sizes, except for gas. If a new type of furnace or boiler could be designed that would be more efficient, it might have an appeal where price is not a major consideration.

Chicago, Ill.—I am in favor of this if one can be properly designed for an economical changeover without appreciable loss of efficiency.

Quincy, Ill.—We are now taking on 18 trial installations of oil and natural gas burners. Thus, the peak load will be handled by oil and the balance with natural gas.

Hillside, N. J.—I am not in favor of such a unit for the type of customer that we serve. However, when viewed from the standpoint of domestic use, a combination furnace would be desirable.

Joliet, Ill.—While such a unit would not be suitable for a residence or small building, it would be good planning for factories and large buildings.

Kansas City, Mo.—We believe that most of the industry, especially the manufacturers, have earnestly and sincerely tried for years to do away with the so-called "do-all" good for everything type conversion furnace. We know that a hand-fired coal furnace, when changed over to oil or gas, is not nearly as efficient as a furnace designed for the fuel used. We feel the general public is being very definitely taken advantage of by the manufacturers who are advocating the installation of basically round coal furnaces. We believe they should state that the furnace has a certain efficiency hand-fired, another efficiency oil-fired and still another efficiency as a gas-fired conversion. These efficiencies should be stated in percentage rather than as good, better and best.

Youngstown, Ohio—I believe that a boiler or furnace capable of burning more than one type of fuel is the answer to present conditions.

Allentown, Pa.—It should certainly not be necessary to marry one type of fuel when a heating system is purchased.

Portland, Oreg.—With the uncertainty of fuel supply, it would seem that the ability to burn more than one type of fuel would be an advantage.

Port Chester, N. Y.—We do not believe conditions warrant the design of a furnace or boiler adapted to more than one type of fuel. It adds considerable cost, and the possibilities for its full use are very remote.

Omaha, Nebr.—In the event of another national emergency, the man who bought equipment which would handle only gas or only oil, may find himself in a very sorry situation.

Danville, Ill.—Dual fuel heating plants would have excellent selling points and would cut conversion costs.

Preview of Events at Chicago

9th International Heating and Ventilating Exposition, International Amphitheatre, January 24-28

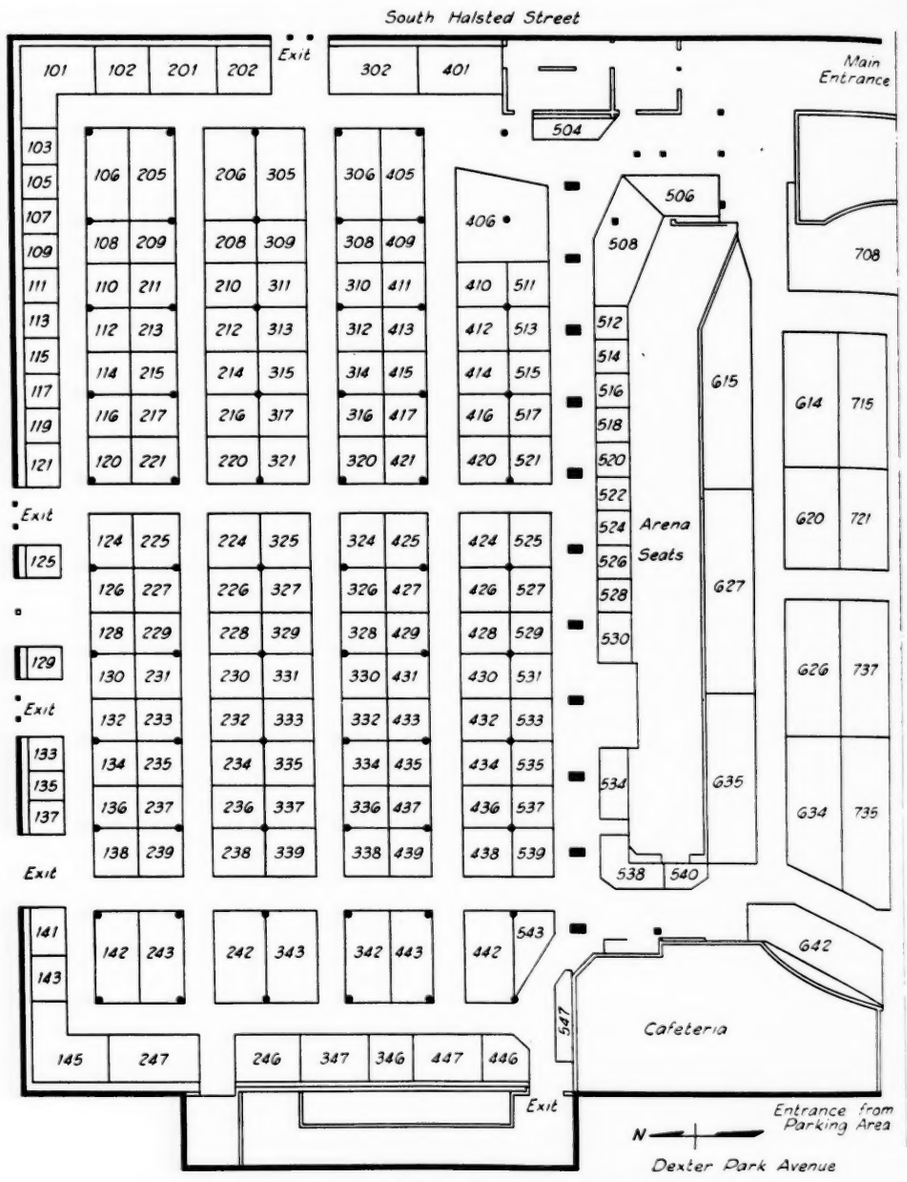
55th Annual Meeting, American Society of Heating and Ventilating Engineers, Stevens Hotel, January 24-27

Two events of interest to heating, ventilating, air conditioning and refrigeration engineers have been arranged for Chicago. The 9th International Heating and Ventilating Exposition will be held January 24-28 in the International Amphitheatre. The 55th Annual meeting of the American Society of Heating and Ventilating Engineers will convene at the Stevens Hotel, January 24-27. Following are the list of exhibitors at the exposition, and the events planned for the convention.

Exhibitors at the International Heating and Ventilating Exposition, International Amphitheatre, Chicago

Exhibitor	Space No.
Ace Engineering Co.	321
Acme Equipment Co.	126
Acme Industries, Inc.	620
Aerofin Corp.	1317
Air Control Products, Inc.	933-935
Air Controls, Inc.	124-225
Air Devices, Inc.	843
Air Filter Corp.	1342
Air-Maze Corp.	141
Air-O-Cel Co.	1211
Airtemp Division, Chrysler Corp.	814
Airtherm Mfg. Co.	1121
Aldrich Co.	243
American Air Filter Co., Inc.	302 & 401
American Artisan	525
American Gas Association	1232-1234
American Hydrovac, Inc.	1340
American Radiator & Standard Sanitary Corp.	708
A.S.H.V.E.	903
American Steel & Wire Co.	232-331-333-335
American Thermal Industries, Inc.	1301
Ames Iron Works	101
Anchor Division, Stratton & Terstegge Co.	912-914
Anderson Co., The V. D.	135
Anemostat Corp. of America	1001-1002-1101
April Showers Co.	119
Armstrong Furnace Co.	311-313-315
Armstrong Machine Works	915-917
Armstrong Steam Trap Co.	915-917
Auer Register Co., The	230
Austin Heating Service	107-109-111
Au-Temp-Co. Corp.	908
Automatic Devices Co.	504
Automatic Products Co.	413-415
Avery Farm Machinery Co., Inc., Hart Burner Div.	1337
Bacharach Industrial Instrument Co.	1322
Bahnson Co.	102
Baltimore Aircoil Co., Inc.	412
Barber-Colman Co.	1343
Barnes & Jones, Inc.	417
Bauer & Black Div., The Kendall Co.	1112
Bearlee Products Co.	921
Bell & Gossett Co.	626
Beverly Shear Mfg. Co., The	328
Borg-Warner Corp., Norge Heat Div.	508
Breuer Electric Mfg. Co.	1313-1315
Brundage Co., The	443
Bryant Heater Co.	1243
Buffalo Forge Co.	216-220
Builders Iron Foundry	117
Builders-Providence, Inc.	117
Bundy Tubing Co.	1339
Burnham Corp.-Boiler Div.	436-438
Carnegie-Illinois Steel Corp.	232-331-333-335
Carrier Corp.	734
Catskill Metal Works, Inc.	923-925
Central States Steel Boiler Co.	554

Exhibitor	Space No.
Century Engineering Corp.	726
Chace Co., W. M.	234
Char-Gale Mfg. Co.	939
Chelsea Fan & Blower Co.	1028-1030
Chicago Blower Corp.	547
Chicago Pump Co.	1021
Chrysler Corp., Airtemp Div.	814
Cinco Window Div.	1327 to 1335
Clarage Fan Co.	1208-1210
Clayton & Lambert Mfg. Co.	1348
Climax Machinery Co.	1328-1330
Coleman Co., Inc., The	1124-1126
Cole-Sewell Engineering Co.	1013
Columbia Steel Co.	232-331-333-335
Combustion Control Corp.	414
Combustioneer Div., The Steel Products Engrg. Co.	1128-1130
Comfort Products Corp.	326
Commercial Filters Corp.	421
Conco Engineering Works, H. D. Conkey & Co.	142
Condensation Engrg. Corp.	514
Connor Engrg. Corp., W. B.	427-429
Continental Air Filters, Inc.	932
Crane Co.	735
Crotty Mfg. Co.	930
Curtis Refrig. Mch. Div., Curtis Mfg. Co.	224-226-228-325-327-329
Cyclone Fence, Div., American Steel & Wire Co.	232-331-333-335
Delavan Engineering Co.	516-518
Dodge Corp., F. W.	231-233
Dole Valve Co., The	424-426
Dollinger Corp.	316
Domestic Engrg. Co.	1042
Dowagiac Steel Furnace Co.	431-433
Doyle Vacuum Cleaner Co.	1344-1346
Dravo Corp.	1242
Dreis & Krump Mfg. Co.	242
Dunham Co., C. A.	308-310-312-314
Duo-Therm Div., Motor Wheel Corp.	145-247
Dwyer Mfg. Co., F. W.	437
Eckhart Mfg. Co.	1027-1029
Emerson Elec. Mfg. Co., The	1017
Empire Stove Co.	943
Fairbanks, Morse & Co.	714
Farr Co.	538
Fasco Industries, Inc.	1220
Fedders-Quigan Corp.	524-526
Federal Boiler Co., Inc.	906
Field Control Div., H. D. Conkey & Co.	1221
Fireline Stove and Furnace Lining Co.	936
Fitzgibbons Boiler Co., Inc.	634
Forest City Foundries Co., The	1233-1235
Frick Co.	202
Frigidaire Div., General Motors Corp.	737
Fueloil & Oil Heat Magazine	1146
General Blower Co.	1207
General Controls Co.	1107
General Electric Co., Apparatus Dept.	1025
General Engrg. & Mfg. Co.	1132-1134-1136-1138
General Filters, Inc.	103
General Fittings Co.	347
Greenlee Tool Co.	1309-1311
Grinnell Co., Inc.	201
Hammond Brass Works	1215
Harris & Co., Arthur	332
Hart & Cooley Mfg. Co.	425
Heat-Timer Corp.	330



Arrangement of exhibits in the north section of the International Amphitheatre, Chicago.

Exhibitor	Space No.
HEATING AND VENTILATING	537-539
Heating, Piping & Air Conditioning	525
Henry Furnace Co., The	1024-1026-1125-1127
Hoffman Specialty Co.	1032-1034
Home Ease Products Co.	941
Hook & Ackerman, Inc.	1226
Holcomb & Hoke Mfg. Co., Inc.	1336-1338
Ilg Electric Ventilating Co.	338-439
Illinois Engineering Co.	1143
Illinois Testing Laboratories, Inc.	911-913
Imperial Brass Mfg. Co., The	138
Independent Register Co., The	317
Industrial Press, The	537-539
Iron Fireman Mfg. Co.	211-213-215-217-221
Jackson & Church Co., Furnace Div.	815
Jefferson Electric Co.	926
Jenkins Bros., Inc.	306
Jenn Air Products Co.	937
Jet-O-Matic Corp.	1326
Johnson Service Co.	1201-1202
Jones & Brown, Inc.	1302
Joy Mfg. Co.	1108-1110
Kaustine Co., Inc.	905
Kehm Corp., The	924
Kent Co., Inc., The	1010
Kewanee Boiler Corp.	416-420
Krueger-Sentry Gauge Co., Inc.	527-529
Lau Blower Co., The	116-120
Lewis & Co., Inc., Joseph E.	137
Libbey-Owens-Ford Glass Co.	235-237
Linde Air Products Co., The	246
Lockformer Co., The	531
McDonnell & Miller, Inc.	942
McQuay, Inc.	1031-1033-1035
Maid-O'-Mist, Inc.	1015
Marsh Corp., Jas. P.	238
Mercoid Corp., The	1137-1139

Arrangement of exhibits in the south section of the International Amphitheatre, Chicago.

Exhibitor	Space No.
Metals & Controls Corp., Spencer Thermo. Corp. Div.	720
Metromatic Mfg. Co.	107-109-111
Metromatic Oil Burner Co.	107-109-111
Meyer Furnace Co., The	343
Mid-Continental Metal Products Co.	1231
Milwaukee Gas Specialty Co.	1228-1230
Minneapolis-Honeywell Regulator Co.	1046-1047
Modine Mfg. Co.	1142
Monarch Mfg. Works, Inc.	105
Morrison Products, Inc.	1217
Morrison Steel Products, Inc.	1229
Mt. Hawley Mfg. Co.	535
Morse-Smith-Morse, Inc.	934
Mueller Furnace Co., L. J.	1037-1039-1043
Nash Engineering Co., The	642
National Air Conditioning, Inc.	346
National Oil Burner Co., Inc.	1325
National Radiator Co., The	106-108
National Tube Co.	232-331-333-335
Nelson Corp., The Herman	715
Newark Transformer Co.	113
New York Blower Co., The	1129-1131
Niagara Blower Co.	835
Olsen Mfg. Co., The C. A.	1024-1026-1125-1127
Owens-Corning Fiberglas Corp.	1114-1116-1120
Pacific Steel Boiler Div., U. S. Radiator Corp.	1012-1014-1016-1020
Patten Co., J. V.	919
Penn Electric Switch Co.	447
Pennsylvania Furnace and Iron Co.	1236-1238
Perfection Stove Co.	1310-1312-1314-1316-1318-1320
Perfex Corp.	428-430-432-434
Petroleum Heat & Power Co.	821
Petrometer Corp.	1147
Pittsburgh Corning Corp.	339
Plibrico Jointless Firebrick Co.	936
Plumbing & Heating Business	110
Plumbing & Heating Journal	528
Prat-Daniel Corp., Thermo Bloc Div.	1209
Proportioneers, Inc., %	117
Pyle-National Co., The	1332-1334
Quiet-Heet Mfg. Corp.	1011
Radiant Utilities Corp.	236
Radiation Furnace Corp.	916
Randall Graphite Bearings, Inc.	324
Raytheon Mfg. Co.	907
Redmond Co., Inc.	1321
Remington Air Conditioning Div.	927-929-931
Research Products Corp.	337
Reynolds Metals Co.	1109-1111
Rheem Mfg. Co.	406-410-511
Richmond Radiator Co.	614
Ric-wiL Co., The	827
Ridge Tool Co., The	1212-1214-1216
Rittling Corp.	1227
Roberts-Gordon Appliance Corp.	1225
Robertson Co., H. H.	334-336
Roth Co., Roy E.	115
Ruby Management Co.	1113-1115-1117
Rusco Awning & Jalousie Div.	1327-1335
Russell Co., The F. C.	1327-1329-1331-1333-1335
S.O.S. Products Co., Inc.	512
Sampsel Time Control, Inc.	947
Sangamo Electric Co.	446
Sarco Co., Inc.	409-411
Schwitzer-Cummins Co.	134-136
Servel, Inc.	1237-1239
Sheet Metal Worker	528
Skidmore Corp.	227-229
Skuttle Mfg. Co.	530
Smith Corp., A. O.	1324
Stefco Steel Co.	130-132
Stewart Mfg. Co., Inc.	209
Sturtevant Div., Westinghouse Electric Corp.	834
Stratton & Terstegge Co.	912-914
Super Electric Products Corp.	1133-1135
Syncromatic Corp.	1106
Snips Magazine	542
Taco Heaters, Inc.	442
Tal Bender, Inc.	129
Temp-Control, Inc.	1307
Tennessee Coal, Iron & Railroad Co.	232-331-333-335
Thatcher Furnace Co.	405
Thermomatic Corp.	1224
Thermoseal Window Div.	1327 to 1335
Thrush & Co., H. A.	520-522
Torrington Mfg. Co., The	342
Trane Co.	615-627
Triad Products Corp.	128
Trion, Inc.	121
Triplex Heating Specialty Co., The	112-114
Turnbull Mfg. and Distributing Co.	1206
Tuttle & Bailey, Inc.	920
United States Air Conditioning Corp.	1036-1038
U. S. Machine Corp.	1246-1347
United States Radiator Corp.	1012-1014-1016-1020
United States Register Co.	239
United States Steel Corp.	232-331-333-335
United States Steel Supply Co.	232-331-333-335
Vibration Eliminator Co., The	910
Viking Air Conditioning Corp.	517-521
Viking Mfg. Corp., The	635
Vulcan Radiator Co., The	1008

Exhibitor	Space No.
Walton Laboratories, Inc.	1007-1009
Waterman-Waterbury Co., The	1006
Watts Regulator Co.	534
Webster Electric Co.	533
Warren Webster & Co.	208 to 214 incl.
Weil-McLain Co.	721
Westinghouse Electric Corp.	305-309
Westinghouse Elec. Corp., Sturtevant Div.	834
Wheeling Furnace Corp.	543
White-Rodgers Electric Co.	205
White Mfg. Co.	1255
Whittington Pump & Engrg. Corp.	513-515
Will-Burt Co., The	928
Wilson & Co., Inc.	506
Wilson Co., The H. A.	133
Wing Mfg. Co., L. J.	320
Worthington Pump & Mchry. Corp.	824
XXth Century Heating & Ventilating Co., The	1213
Yarnall-Waring Co.	435
Young Radiator Co.	206
Zone-Heat Regulator Co.	143

55th ANNUAL MEETING
AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

January 24–27, 1949 • Stevens Hotel, Chicago, Ill.

Saturday – January 22

10:00 a.m. Committee on Research Meeting

Sunday – January 23

11:00 a.m. Council Meeting
2:30 p.m. TAC on Industrial Ventilation
2:30 p.m. TAC on Panel Heating and Cooling
4:00 p.m. Chapter Delegates Meeting
7:00 p.m. TAC on Combustion

Monday – January 24

9:30 a.m. Business Session
Reports of Officers and Committees
Report of Committee on Research, by L. N. Hunter, Chairman
Technical Session
Physiologic Adjustments of Normal Subjects and Cardiac Patients to Sudden Change in Environment, by Nathaniel Glickman, Tohru Inouye, R. W. Keeton, M.D., I. R. Callen, M.D., F. K. Hick, M.D., and M. K. Fahnestock
Overall Coefficients for Flat Glass, Determined under Natural Weather Conditions, by G. V. Parmelee and W. W. Aubele

12:15 p.m. Welcome Luncheon
Speaker: Dr. Henry T. Heald, President, Illinois Institute of Technology

1:30 p.m. Chapter Delegates Meeting
2:00 p.m. Opening 9th International Heating and Ventilating Exposition, (International Amphitheatre)
2:30 p.m. TAC on Air Cleaning
2:30 p.m. TAC on Air Distribution
2:30 p.m. TAC on Heat Flow through Glass
2:30 p.m. TAC on Sound Control
2:30 p.m. TAC on Heat Pump
2:30 p.m. *Guide* Publication Committee
7:00 p.m. TAC on Cooling Load
7:00 p.m. TAC on Panel Heating and Cooling—Group B
7:00 p.m. TAC on Heating Load
9:00 p.m. Informal Party

Tuesday – January 25

9:30 a.m. Technical Session
The Internal Performance of an Induced Draft, Packed Cooling Tower, by N. W. Snyder
Heat Transfer Rates for Refrigerant Boiling in Horizontal Tube Evaporators, by L. G. Seigel, W. L. Bryan and M. C. Huppert
Psychrometric Factors in the Air Conditioning Estimate, by C. M. Ashley

12:30 p.m. Luncheon Meeting
Speaker: Cyril Tasker, Director of Research, ASHVE
2:00 p.m. Tour of Merchandising and Testing and Development Laboratories, Sears, Roebuck & Co.
2:30 p.m. TAC on Weather Design Conditions
2:30 p.m. Chapter Delegates Meeting
2:30 p.m. Tour—Plant of Ilg Electric Ventilating Co.
2:30 p.m. TAC on Insulation
4:30 p.m. Committee on Research Meeting
6:30 p.m. Past Presidents' Dinner

Wednesday – January 26

9:30 a.m. Technical Session
Are Automatic Air Shutters Justified on a Gas-Fired Conversion Burner?, by W. M. Myler, Jr., and H. W. Nelson
Performance of Fourteen Masonry Chimneys under Steady State Conditions, by P. R. Achenbach and S. D. Cole
Performance of Residential Chimneys, by L. B. Schmitt and R. B. Engdahl

2:00 p.m. Technical Session
Performance of an Electrical System of Panel Heating with Four Stages of Insulation, by R. J. Lorenzi and J. F. Schreiber
Heating a Basementless House with Radiant Baseboard, by R. H. Weigel and W. S. Harris
Heating Panel Time Response Study, by A. B. Algren and Ben Ciscel

7:00 p.m. Annual Banquet
Toastmaster: John Howatt, Past President, ASHVE
Speaker: Dr. Clark G. Kuebler, President, Ripon College, Ripon, Wis.
Subject: Formula for Freedom

Thursday – January 27

10:00 a.m. Technical Session
Turbulence in Air Distribution, by H. B. Nottage
Adjustment and Balancing of the Air Delivery through a System of Manifold Air Diffusers, by G. S. Dauphinee and Peter Argentieri
Air Distribution and Draft, by John Rydberg and Per Norback
Society Business
Resolutions
Installation of Officers

12:30 p.m. Nominating Committee Luncheon
1:00 p.m. Council Luncheon Meeting
1:30 p.m. Tour—McDonnell & Miller, Inc.

THE SALES ENGINEER

Friends Can Assist the Sales Engineer

BERNARD LESTER
Sales Engineering Consultant

WE all know the sales engineer who is a lone wolf—he who sells the hard way. He depends only on his own skill and does not use all the resources available. Consequently his efforts are not multiplied.

Sometimes what others say about you, your product, and your services count for more than what you say yourself. The lone wolf sales engineer is not quick to make friends. Since he does not help them, he cannot expect help from them.

Imagine every prospect as located in the center of a circle. The skilled sales engineer thinks of every "arrow of influence" that can be shot toward the prospect, no matter from what direction. Such arrows of selling influence are of three kinds:—

Those that the sales engineer directs through his personal selling effort.
Those that spring from advertising and sales promotion.
Those that reach the prospect from other parties,—words said by friends.

No salesman can be in a preferred position with every prospect and purchaser. He can come much nearer to being so by getting the help of others—by tapping all the resources of friendly help.

Where can the sales engineer ordinarily get help? Examples such as these, may show:—

In a Midwestern town a sales engineer for an air conditioning manufacturer was trying to sell an installation to a leading department store. He found out where this department store did its banking. He met the officials of the bank, and got their attention and interest. He told them of the advantages of air conditioning and results from the use of his apparatus and his company's services. He told them how the use of his equipment and services would help this department store prosper—consequently increase its banking business. The officials of the bank helped him by pointing to the key men to contact. They said a good word to the officials of the department store.

Sales engineers sell an "investment"—not an "expense item." Bankers are interested in making investments, just as sales engineers. Both want to see capital furnished for efficient production. Both should be interested in such matters as the growth of manufacturing and commercial establishments through rehabilitation and extension. Due to these facts, and that the local up-to-date bank is in close touch with business concerns in its area, the two can work very closely together. The initiative must come from the sales engineer and often he can get leads or tips, or specific help with certain important prospects.

There are plenty of examples too, of sales engineers, who even in dull times, have been able to make possible the sales of an installation by convincing the bank and the prospect of the advisability of making and receiving a loan.

Sales engineers can often get help from non-competitive salesmen who sell the same customers. This is particularly true in those large areas where each salesman follows a route visiting his prospects and customers rather infrequently. One case, for example, is of an electrical machinery salesman and a fan blower salesman, both of whom cover a mining district, where travel is difficult. These two salesmen help one another—operate as scouts and checkers on customers' needs and pending negotiations. This type of friendship between sales engineers can often be very productive when each has faith in the other and can interchange information.

For the heating and ventilating equipment sales engineer the architect, consulting engineer or contracting engineer can be of the greatest assistance. Of course, it is common for such sales engineers to develop friendships with such helpful forces as these. But it so often occurs that he limits himself only to the architect, engineer or contractor who is a particular factor on a particular job. He fails to consistently extend his acquaintanceship over a larger circle, appreciating that at some time or other he can use friendships thus formed.

A few years ago a sales engineer found himself floundering in his attempts to reach officials connected with a large manufacturer in the market for his equipment. This manufacturer did a large amount of advertising, placed through an agency employing a friend of the sales engineer. He got the help of this man and through him, others in the agency. Not to sell his fans and blowers—no, that was his job. But to meet—and in the right way—certain officials in his prospect's organization. This assistance definitely helped him to gain consideration by the prospect and to get the order.

The successful sales engineer is ever alert to friendships that will help. Making friends broadens the man, multiplies his efforts, and extends his influence. Friendship must follow a two-way path—help others and they will help you.

Experience is my Classroom

By T. W. REYNOLDS

RADIATOR RATINGS

It was commonly thought that the old column radiators were rated on actual surface and some even thought the surface had a definite thermal output regardless of width, height and length. The radiator generally had somewhat less of actual surface than its rated surface, because the ratings were given in the nearest fraction and their output per square foot of rated surface varied from 225 Btu up to 282 Btu for one column 26 in. high. Contractors generally used 225 Btu in their calculations as they usually installed the cheapest radiator—in those days a 3-column radiator, 38 in. high. Radiators varied in price, because the machining where sections were joined was a constant regardless of radiator size.

At one time a square foot of radiation was supposed to give off 250 Btu, or to use up ¼ lb of steam, low pressure steam being commonly taken at 220F with latent heat at 1,000 Btu for convenience in figuring. Later the temperature of the steam was given as 215F and the latent heat at about 960F, so the condensation per square foot was still conveniently left at ¼ lb. For years we had the same sort of thing in ventilation, 30 cfm of outdoor air, first to reduce the carbon dioxide content of air to proper proportions, then when this carbon dioxide content was found to be of no great importance, we still found that 30 cfm was required to remove the body envelope of heat. We engineers can prove anything.

The most violent objections to any change from this method of rating came from those engineering offices which commonly laid out hot water heating systems. They complained that terming one square foot of surface that amount of surface which emitted 240 Btu would throw off their calculations and pipe sizes. Yet, it was a precise and more scientific way of going about the matter. Radiators in a building were not always of one height or width, so it was quite common for some of these offices to call up the manufacturer to find out the output of the elliptical or column radiator most used on a particular installation. This no longer need be done under the new (present) method of rating.

Somewhat later, the U. S. Government rated all radiators on their actual surface in the interests of standardization and many were the calls received from consulting engineers on government work as to just what could be done about the matter, for it again upset their calculations, so they said.

Ratings of tubular radiators are based on 8 to 10 sections, the usual radiator length. End sections, have a large amount of radiant surface and affect the output of the assembly. Therefore, a radiator of but few sections, such as one in a bath room, gives off more heat than its rated output, but this end effect was much more pronounced in the elliptical or column type of radiator.

SIGNS OF THE TIMES

In 1306 the burning of coal was forbidden in England as injurious to health. In 1775, soot was identified with chimney sweeps' disease, a cancer of the scrotum. It is said that cancer can also come about from radiation of various kinds, for example, sunlight on the hands, neck, face and lips.

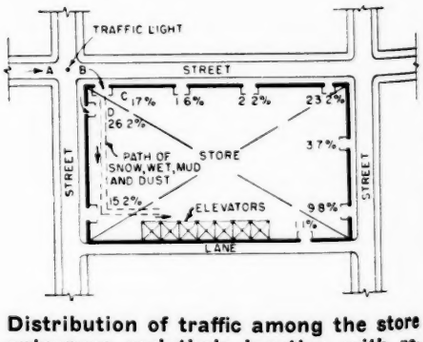
TRACKING OF SNOW AND MUD INTO PUBLIC PLACES

One of the problems in the northwest of this country, or wherever subzero temperatures occur, is just how to prevent snow with its attendant mud from being tracked into public places such as stores. This problem is typified by the accompanying illustration of a store wherein melted snow is tracked in all the way from its two corner entrances at *C* and *D* to the bank of elevators at the rear. Although the store is provided with electrostatic filtration at a considerable first cost, yet here we have mud from snow, with the dust from the mud by-passing the filters.

Since the store is already there it would be rather difficult and expensive to install snow melting pipes under its surrounding sidewalks. In any event, this would not be the answer to the problem, because the dirt is tracked in, even though the store management keeps the sidewalks freed of snow almost as fast as it falls. Now, the real cause of the wet tracking within this store lies beyond the sidewalks at the crosswalk *B*, at which point the amount of traffic is greatest. This is because the traffic in and out of stores goes mainly to corner entrances to where the streets intersect, as will be noted by the given percentage of traffic at each entrance of the subject store.

Where the climate is severe and often successively so for a matter of days, the snow as it falls upon the streets becomes packed into ice and stays around to collect soot and other dirt. Then the sun around midday melts the blackened surface to a slight extent, so that it becomes tracked into the store through the most popular entrances, which in the store in question, are the entrances *C* and *D*. The popularity of this corner is particularly emphasized at entrance *C*, where of two doors in this entrance, the one nearest the corner receives most of the traffic passing through that entrance.

Shovelling the crosswalk *B* so as to free it of all snow would seem to be the answer. This has been done, but the trouble is the crosswalk doesn't stay clean. Cars stop at *A* when the traffic light directs, then go with the green and kick or transport the snow from *A* to *B*. Another answer would seem to be the installation of a heated grating from the entrances all or a part of the way to the elevators, but how should this be done? If the heat is blown out through the grating, it adds to the heat of the main store floor where in holiday season cooling is resorted to for the purpose of reducing heat gain. This method also adds humidity to a place already high in humidity, and, of course, it blows the dust around. Reversing the air flow so as to exhaust down through the grating would give less disadvantages, since heat, dust and humidity would then be removed from the store. One disadvantage, however, would be the tendency to put the floor under suction and make the conditions drafty for some distance in from the entrance, though this could be offset by an equal amount of supply elsewhere.



Distribution of traffic among the store entrances and their location with respect to the elevators.

Note: Mr. Reynolds is Chief, Air Conditioning Division, Abbott, Merkt & Co., Engineers, New York.

Whether one supplies or exhausts air through a grating, it still remains as a grating of poor appearance and more or less slippery. Duct openings below the grating must be adjusted throughout the length of grating for equal air flow, while the holes in the grating must be small, yet not so small as to clog up too often with dirt. Perhaps the best approach to this problem is to remove the snow mechanically from the feet of the patrons by forcing their cooperation. For example, any surface which makes walking on high lumps of snow somewhat uncomfortable tends to make most any person who walks over it kick the snow off by scuffing of the feet on its surface.

Coconut or fiber matting should present such a surface. This material is obtainable in most any width and length. Its weave easily passes dirt and dust from the shoes, so that the surface of the matting can be kept reasonably clean for quite some time. If this matting were placed over a heated grating and thus continued for some distance in from those entrances which offend, any steam pipes below the grating would melt the snow brought in on the shoes and would allow both the dirt and moisture to be passed through to the space below. If a fan drew air through the matting, the passage of dirt would be accelerated and some arrangement could be made for arresting the dirt, or the space below the gratings could be cleaned at the end of the day. The gratings could be covered with a carpet or some other hard wearing material when the matting is not required.

No doubt the air movement from the fan would facilitate parting of the snow from the shoes by contacting more of the snow and by passing more heat over it in a given time than by conduction alone. Conduction from the grating as heated by the pipes could still be present to add its effect. Obviously, snow will part from a shoe in a very short distance, providing heat can be made to penetrate to the frost on the sole of the shoe so as to release the snow.

Incidentally, exhaust air would not have to be made up if the exhaust air is recirculated and blown into the vestibules at entrances. While this method would heat the entrances to advantage, it would require that the exhaust air be filtered, in which case service at filters would be high, unless electrostatic filtration were installed.

AN EXPERIENCE WITH A GLASS DOOR

A modern department store often has rows of glass doors around the first floor perimeter, all adding to the heat gain. There is also a vertical space of about ⅜ in. for clearance between one door and the next, and out through this space goes the air, rejected or otherwise. The mechanism for locking these doors is at the top and this is not well known, so that with the store dimly lighted and closed, passersby may try the doors, find them locked and be mystified.

These doors are manufactured under a tension which it is possible to release, especially when the door is struck on the edge, say, by a baby carriage while passing through. Blow ups are said to be rare, one-eighth of one percent, but they have occurred and the writer saw one which did so explode while the door was still locked and the store unopened to the public.

For about fifteen minutes after the initial noise had attracted attention, small pieces of glass continued to project themselves from the door for a distance of fifteen to twenty feet. A curious workman then walked over and touched the door. Instantly the door collapsed in fragments at his feet.

EVERYTHING UNDER CONTROL

When it comes to speed control of fans, the writer likes the kind that he can walk up to and just twirl a gadget or press a button and immediately get any degree of control he wants. Variable inlet vane control or equivalent control of any kind is a life saver in many an installation. In a large store there may be a number of existing fans whose performance in connection with altered duct systems cannot be predicted in advance, but just add the necessary control and you can get any reduction desired.

Such control cannot be added, however, when the fan has double inlets, unless one bearing is lengthened, and this is out of the question. Another case where this form of control would not be suitable is one where the inlet to an existing fan would become too close to a wall, since the control makes an extension to the fan inlet of about a foot.

With adequate speed control one can slow down a fan wherever the velocity of air becomes too great through an electrostatic filter, an air washer, or any other equipment. Speed control is also advantageous wherever departments are changed, reduced in size or in heat gain, where air movement in the conditioned space or from outlets becomes too great, or where the ducts are noisy or the static pressure less than estimated. A certain amount of excess capacity in a system can also be throttled down, then in later years as the equipment offers more resistance due to dirt that is not readily accessible, the system can be adjusted upwards.

GIVE THE FAN AIR

Not too infrequently one will come across a fan that is pulsating in operation because the fan inlet is so crowded that the air cannot flow uniformly into it. Now, the distance required from fan inlet to wall depends upon the particular manufacturer or engineer you ask, being as low as 60%, but usually two-thirds, of the diameter of the fan inlet or the fan wheel. This presumes that there are no obstructions around the fan and that the air comes to the fan inlet from all directions.

The preferred distance is 100%, of course, especially so as there is always the temptation by others to steal a few inches upon installation. Incidentally, both inlets of a double width double inlet fan should have the same access or free area provided; otherwise one half of the wheel will provide more air than the other half.

GETTING THE WORK DONE

Today when the writer gets a job to do he approaches it as a task which must be gotten over with, the sooner the better. In younger days, it was different, since the task was never met before, it was more interesting. Why get the job done and spoil the fun. So the slide rule was handled with loving care. He did not want to let go of it, though he did keep one hand free for the layout. With this layout he played as a cat would with a mouse, then as he fell in love with it, pondered, theorized and fussed over trifles. Meanwhile, the calculations were dressed up with a lot of imposing formulas having all the letters of the alphabet. Instead, he could have set down the actual figures and have gotten somewhere.

Therein, the colleges fall down. "Time the essence of the contract," as we commonly write in our specifications, is never stressed by them. The viewpoint seems solely one of presenting to the student an art or interesting profession, rather than the making of a dollar out of all this manipulation of books, formulas, slide rules and test tubes.

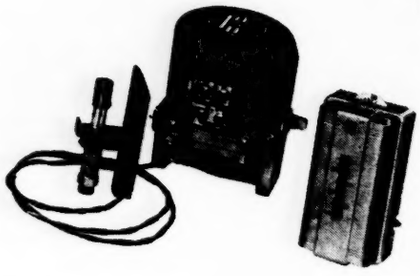
When we write in college the interesting statement that A B = C D, we do so because the letters stand for all the A Bs and C Ds we will meet up with later in life when these are tuned in for equality. Out in life, however, we have but one set of figures at a time, so why not use the figures. The heck with all these letters.

Youth, already by nature one-sided and self-interested, is taught that the world is his and there to capture. Colleges, however, would produce more balanced men if they but stressed the two or several sides to every question —the fact that money is not made solely because of academic knowledge —but rather by how we exercise such knowledge, how we build it up and the rate of production we achieve with its help.

NEWS OF EQUIPMENT AND MATERIALS

Time Modulation

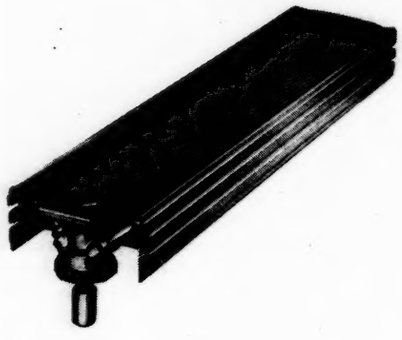
NAME — Minneapolis - Honeywell time modulation for gas burner.
PURPOSE — System of control designed to control the off period of gas burner operation in order to



provide better temperature control.
FEATURES—A plug-in type of transformer, is plugged into the most convenient power outlet, and the low voltage wires to the valves. The system consists of a time modulation thermostat, a power-pile gas control system with the electric power supplied by the thermopile. Method of control varies the cycle length and frequency of burner operations in accordance with outside temperature conditions. The V898 valve is of the diaphragm type operated by a small magnetic relay which functions at a low sound level.
OPERATION — When the thermostat contacts close, the relay coil is energized thereby pulling in the relay. This closes the gas supply port and opens the bleed port. The small amount of gas on top of the diaphragm bleeds momentarily and reduces the pressure above the diaphragm thereby permitting the gas pressure under the diaphragm to open the main valve port. When the thermostat contacts open, the relay coil is de-energized thereby dropping out the relay. This closes the bleed port and opens the gas supply port; thus increasing pressure above the diaphragm forces the valve closed.
LITERATURE AVAILABLE—Illustrated folder.
MADE BY — *Minneapolis-Honeywell Regulator Co., Minneapolis 8, Minn.* 1

Convector

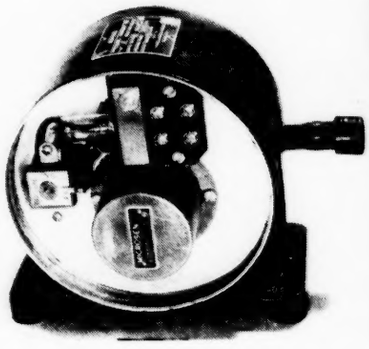
NAME—Modine Quiet-Seal.
PURPOSE—Convector for one-pipe steam heating system.
FEATURES—Design is said to eliminate water hammer, gurgling noises, air binding, spitting of water from air vents, and reduced heating capacity. Unit is said to avoid counterflow of steam and condensate in the same passages. Steam, condensate and air all flow in the same direction. Condensate is returned to a built-in trap or water seal from which point it overflows and drains into the supply branch. This seal permits free and easy venting and eliminates resultant air binding and water logging. Output from convector can be modulated by a built-in damper thereby overcoming the use of on or off valves.
LITERATURE AVAILABLE—Bulletin 249-B.



SIZES AND CAPACITIES — In 10 lengths from 20 to 64 in.; in heights, 18 to 32 in.; and in depths of 4, 6, 8, 10 in.
MADE BY—*Modine Manufacturing Co., Racine, Wis.* 2

Pressure Transmitter

NAME—Microsen pressure transmitter.
PURPOSE—For transmitting pressure indications to milliampere or millivolt instruments.
FEATURES — Pressure motion is picked up from the tip of a Bourdon tube and by means of an electro-mechanical relay this motion is converted into a d-c signal to be indicated or recorded with milliampere or millivolt instruments. Since the electrical output is directly proportional to the movement of the tube, it is possible to use uniformly graduated scales.



Power consumption is said to be only 2 watts. Maintenance has been simplified by the case construction which enables servicing either the pressure system or the electrical system independently of each other. Case is of cast aluminum. Bourdon tubes are made of alloy steel, bronze, stainless steel, and other metals to meet specific service requirements. Operating voltage is 115 volts at 50 to 60 cycles. Available in pressure ranges up to 50,000 lb.
LITERATURE AVAILABLE—Bulletin No. 145.
MADE BY—*Manning, Maxwell and Moore, Inc., 11 Elias St., Bridgeport, Conn.* 3

Primer

NAME—Rust-o-primer.
PURPOSE—To eliminate the need of removing rust or the necessity of having a surface perfectly dry before painting.
FEATURES—Material is a combination chemical pretreatment and primer for metal. A vinyl base, quick drying wet primer is applicable over wet or dry, clean or rusted metal including steel, aluminum, or galvanized coat in order to provide a hard, paintable foundation for any type of paint.
MADE BY—*The Wilbur & Williams Co., Greenleaf and Leon Sts., Boston 15, Mass.* 4

Bind in.

PHYSICAL PROPORTIONS OF CENTRIFUGAL FANS

The tables on these pages are continued from last month's data sheet and, as with those data, are reproduced by permission of the National Association of Fan Manufacturers. Both Tables 3 and 4 apply to non-overloading, multiblade fans, Classes I and II (Class I fans are those with a maximum total pressure of 3¾ inches; Class II, 6¾ inches).

In these tables, symbols or letters under each manufacturer's name refer to his model or type number; numbers in body of table are size number of that type.

Table 3. Single Inlet, Single Width Multiblade Fans

(Non-Overloading, Classes I and II)

*Standard Index Number	American Blower Corporation		Bayley Blower Company		Buffalo Forge Company	Clarage Fan Company		Garden City Fan Company		Ilg Electric Ventilating Company		Herman Nelson Corporation		New York Blower Company		The Trane Company		Westinghouse Sturtevant Division
	Sirocco	HS 81	Plezi-form	Aero-plex	LL	NL	NH	B	NOL	B BW	BC	FAN GAN	FBN GBN	ME SS	ME PL	FC	BI	SV-10
A	122	122	122	122	2	1	1	2				1200	1200	122		12	12	52½
B	135	135	135	135	2¼	2	2			25	25							55
C	150	150	150	150	2½	3	3	2½				1500	1500	150		15	15	57½
D	165	165	165	165	2¾	4	4			30	30							60
E	182	182	182	182	3	5	5	3		35	35	1800	1800		182	18	18	62½
F	200	200	200	200	3¼	6	6		3			2000	2000					65
G	222	222	222	222	3¾	7	7	4	4	40	40	2220	2200		222	21	21	67½
H	245	245	245	245	4	8	8			45	45	2400	2410			24	24	70
I	270	270	270	270	4½	9	9	5	5	50	50	2700	2700		270	27	27	75
J	300	300	300	300	5	10	10	6	6	55	55	3000	3000			30	30	80
K	330	330	330	330	5½	11	11	7	7	60	60	3300	3300		330	33	33	85
L	360	360	365	365	6	12	12		7½	WN65	65	3600	3600	365	365	36	36	90
M	397	397	402	402	6½	13	13	8	8	WN70	70	4000	4000	402	402	40	40	95
N	440	440	445	445	7	14	14		8½	WN80	CN80	4400	4400	445	445	44	44	100
O	486	486	490	490	8	15	15	9	9	WN90	CN90	4900	4900	490	490	49	49	105
P	537	537	542	542	9	16	16	10	10	WN100	CN100	5400	5400	542	542	54	54	115
Q	593	593	600	600	10	17	17	11	11	WN110	CN110	6000	6000	600	600	60	60	125
R	657	657	660	660	11	18	18		12	WN120	CN120	6600	6600	660	660	66	66	135
S	726	726	730	730	12	19	19	12	13			7300	7300	730	730	73	73	145
T	803	803	807	807	13½	20	20	13	14							81	81	155
U	887	887	890	890	15	21	21	14	15							89	89	165
V	980	980	982	982	16½	22	22	16	16									175
W	1082	1082	1087	1087	18	23	23	17	17									185
X	1195	1195	1200	1200	20	24	24	18										
Y	1320	1320	1325	1325	22	25	25											

*Refer to Index Numbers, Table A, last month's data sheet.

Table 4. Double Inlet, Double Width Multiblade Fans

(Non-Overloading, Classes I and II)

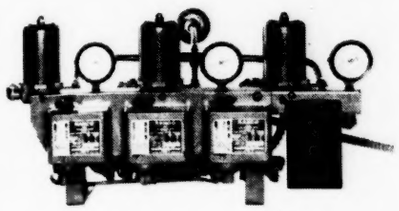
* Standard Index Number	American Blower Corporation		Bayley Blower Company		Buffalo Forge Company	Clarage Fan Company		Garden City Fan Company		Ilg Electric Ventilating Company		Herman Nelson Corporation		New York Blower Company		The Trane Company		Westinghouse Sturtevant Division
	Si-rocco	*HS 81*	*Plexi-form*	*Aero-plex*	*LLD*	*NL*	*NH*	*B*	*NOL*	*B BW*	*BC*	*TFAN TGAN*	*TFBN TGBN*	*ME SS*	*ME PL*	*FC*	*BI*	*SV-10*
A	122	122	122	122		1	1					1200	1200			12	12	52½
B	135	135	135	135		2	2			25	25							55
C	150	150	150	150	2½	3	3					1500	1500			15	15	57½
D	165	165	165	165	2¾	4	4			30	30							60
E	182	182	182	182	3	5	5	3		35	35	1800	1800		182	18	18	62½
F	200	200	200	200	3¼	6	6		3			2000	2000					65
G	222	222	222	222	3¾	7	7		4	40	40	2200	2200		222	21	21	67½
H	245	245	245	245	4	8	8	4		45	45	2400	2400			24	24	70
I	270	270	270	270	4½	9	9	5	5	50	50	2700	2700		270	27	27	75
J	300	300	300	300	5	10	10	6	6	55	55	3000	3000			30	30	80
K	330	330	330	330	5½	11	11	7	7	60	60	3300	3300		330	33	33	85
L	360	360	365	365	6	12	12		7½	WN65	65	3600	3600	365	365	36	36	90
M	397	397	402	402	6½	13	13	8	8	WN70	70	4000	4000	402	402	40	40	95
N	440	440	445	445	7	14	14		8½	WN80	CN80	4400	4400	445	445	44	44	100
O	486	486	490	490	8	15	15	9	9	WN90	CN90	4900	4900	490	490	49	49	105
P	537	537	542	542	9	16	16	10	10	WN100	CN100	5400	5400	542	542	54	54	115
Q	593	593	600	600	10	17	17	11	11	WN110	CN110	6000	6000	600	600	60	60	125
R	657	657	660	660	11	18	18		12	WN120	CN120	6600	6600	660	660	66	66	135
S	726	726	730	730	12	19	19	12	13			7300	7300	730	730	73	73	145
T	803	803	807	807	13½	20	20	13	14							81	81	155
U	887	887	890	890	15	21	21	14	15							89	89	165
V	980	980	982	982	16½	22	22	16	16									175
W	1082	1082	1087	1087	18	23	23	17	17									185
X	1195	1195	1200	1200	20	24	24	18										
Y	1320	1320	1325	1325	22	25	25											

*Refer to Index Numbers, Table A, last month's data sheet.

Capacity Control

NAME—Brunner capacity control system for refrigeration compressors.

PURPOSE—Suction valve unloaders to reduce the capacity of the com-



pressor. Control designed for use where refrigeration requirements vary so widely that control of temperature by an on-off operation of the unit is impractical.

FEATURES—Unloading is automatic. One or more cylinders are cut out of service in response to temperature or pressure changes. Operation of capacity control is such that a much closer control of temperature is maintained than by ordinary start-stop operation. Makers claim that it is possible to specify a unit of ample size in anticipation of future requirements without the danger of short cycling during periods of limited refrigeration demand. Equipment is arranged for easy servicing. Assembly is available as a package for installation in the field on any Brunner compressor from 7½ to 30 hp.

LITERATURE AVAILABLE—Form 445.

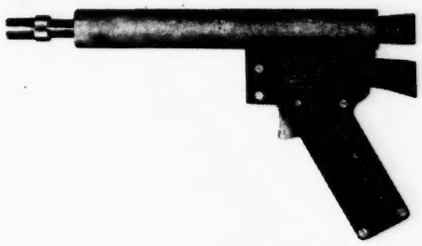
MADE BY—*Brunner Manufacturing Co., Utica 1, N. Y.* 5

Welding Process

NAME — Aircomatic welding process.

PURPOSE—A rapid means for welding heavy sections of aluminum and aluminum alloys at wire feed speeds ranging from 100 to 300 in. per min.

FEATURES — Process consists of feeding consumable wire through a manually operated welding gun. Metals being welded are shielded from the air by an inert gas. With this unit welding of aluminum may be performed in flat, horizontal, vertical, and overhead positions. Argon has been found to be a satisfactory shielding gas for aluminum welding. Only three sizes of filler metal are required—3/64, 1/16, and 3/32 in. With these filler metal sizes the overall current consumption is 70 to 450 amperes which permits welding of metal in thicknesses from 1/8 to 2 in. Parts of the unit are the welding gun, gas hose, concentric with which is the metallic tube for conveying welding wire, a three-conductor control table, feed motor box, control box and wire reel. Welding gun is equipped with a trigger which readies the unit for welding and a button for feeding the wire when not welding. When arc voltage is established, controls operate



to energize the feed motor and deliver filler metal.

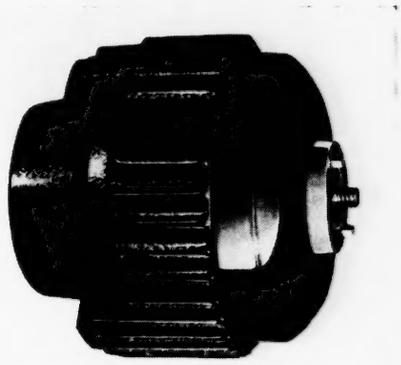
MADE BY—*Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y.* 6

Motor

NAME — MonoMotor, type AM 4-pole shaded pole single bearing motor.

PURPOSE — Low-range power unit for refrigeration, air conditioning, heating, ventilating, and other single bearing motor applications.

FEATURES — A large oil reservoir isolated from heat and permanently sealed, in addition to a high oil holding capacity of an inorganic packing, provide improved lubricating action. Forced feed lubrication of bearing surfaces is achieved by a spiral pump incorporated on the shaft. Oil return ducts are included to permit recirculation of lubricant back to the reservoir. Aluminum rotor is held in position in the field area by magnetic forces, thereby minimizing end thrust. Stator windings are impregnated with a humidity resistant varnish. Cast iron case has functional fin line



design to accelerate heat dissipation.

SIZES AND CAPACITIES — In models up to 9 watts output.

MADE BY — *Redmond Co., Inc., Owosso, Mich.* 7

Oil Burner

NAME—York-Heat burner model N-38.

PURPOSE—Space heating.

FEATURES—Model employs dual nozzles in order to achieve the desired firing rate of from 5 to 10 gal per hr while utilizing a con-

ventional 1/6 hp motor, operating at fan and pump speed of 1725 rpm. The dual blast tube has been eliminated except for a short section used to support the nozzle pipe assembly.

MADE BY — *York-Shipley, Inc., York, Pa.* 8

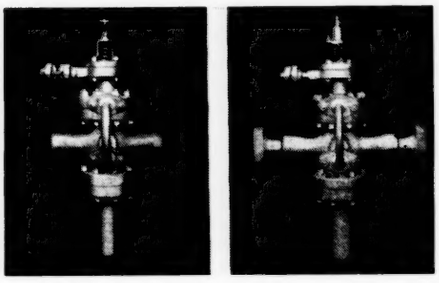
Jet Pump Motors

NAME—FHP jet pump motors.
PURPOSE — Line of fractional hp motors for use with jet pumps in ratings of from ¼ to 1 hp.
FEATURES — Motors are equipped with ball bearings for long life on

thrust loads. A tapped hole is provided in the top end shield for attachment of a drip cover. The single-phase types each have a built-in automatic reset thermotector for overload protection. Motors are adaptable for either horizontal or vertical end mountings. Two lines are available, one with plain shaft extension for coupling to a stub shaft on which the impeller is mounted and one with threaded shaft extension for direct mounting of the impeller.
SIZES AND CAPACITIES—Type SKH, split-phase, in ¼ and 1/3 hp; type KC, capacitor-start, all ratings; type K, three phases, ¾ and 1 hp only; type BC, direct current, compound wound, 1/3, ¾, and 1 hp only.
MADE BY — *General Electric Co., Schenectady 5, N. Y.* **9**

Pressure Reducing Valve

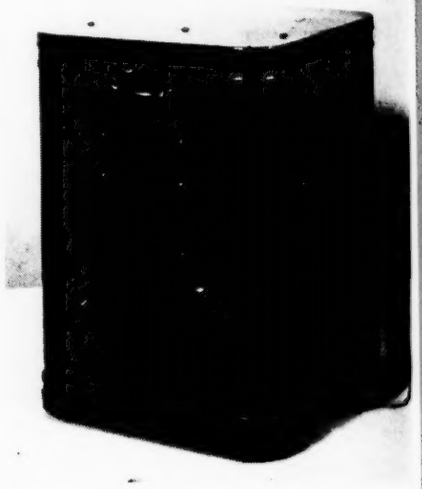
NAME—Leslie high pressure reducing valve.
PURPOSE—Valve for reducing pressure in steam, air or gas service.
FEATURES—No change of spring or diaphragm is required for a minimum or maximum reduced pressure setting. Valve is single seated, closing with the inlet pressure for positive dead-end shut off. Interchangeability of replacement parts make a complete overhaul possible without removal of the main body from the pipe line. Main valve is hardened stainless steel with stellited seating surface. Cylinder liner and piston are made of hardened stainless steel. Valve has a monel diaphragm. To eliminate the effect of turbulence and pressure drop at the outlet body throat, an external pipe connection for reduced pressure is furnished.
SIZES AND CAPACITIES—In sizes 1, 1¼, 1½, and 2 in., with series 90 or 150 flanges or welding ends. Valve handles inlet steam pressures from 300 to 1500 lb per sq in. and air or gas inlet pressures from 300 to 3000 lb per sq in. Reduced pressure range is from 100 to 600 lb per sq in.



MADE BY—*Leslie Co., 52 Delafield Ave., Lyndhurst, N. J.* **10**

Package Dehumidifier

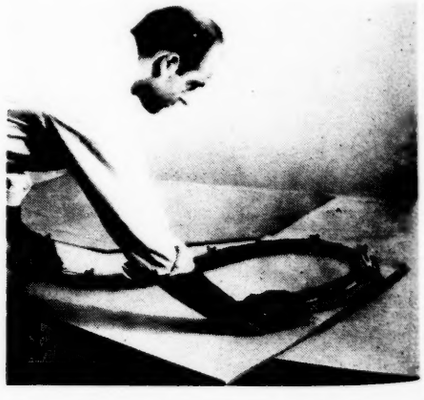
NAME—Dapco air dryer.
PURPOSE—Preservation of materials from damage caused by high humidity in basements, stock rooms, and other places.
FEATURES—Unit is of all aluminum construction. Machine is of a solid adsorption type and meets Navy Department specifications CS-P-242. Model SOR-8 is for use in spaces up to 5000 cu ft. The air flow is 23 cfm and it uses from 0.65 to 0.90 kwhr per lb of water removed. Connected load on reactivation is 850 watts; on adsorption, 50 watts. Intermittent drying and reactivation is automatic. Unit may be started either manually or operated by humidistat control.
SIZES AND CAPACITIES—At 73F dew-point it can remove 8 lb of water per day and at 41F dew-point, 5 lb of water per day. Cabinet measures 15 by 13 by 18¾ in. high.
MADE BY — *Dry Air Products*



Corp., 734 Jackson Place, N. W., Washington, D. C. **11**

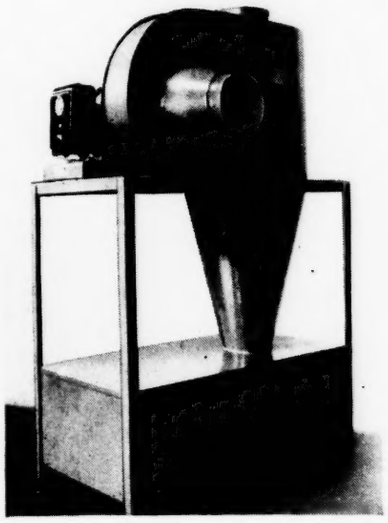
Template

NAME—Flexible template.
PURPOSE—For drawing curves.
FEATURES—Template is capable of duplicating curves full size. It can be set and locked to any desired shape, contour, curve or radius and transferred in this position. Template springs back to original position when unlocked and is again ready for use. Rugged spring steel and aluminum are used in this construction.
SIZES AND CAPACITIES—Available in lengths 2 ft and longer.
DISTRIBUTED BY—*C. H. Clark and W. E. Poggenburg, 4900 Wynnefield Ave., Philadelphia, Pa.* **12**



Dust Collector

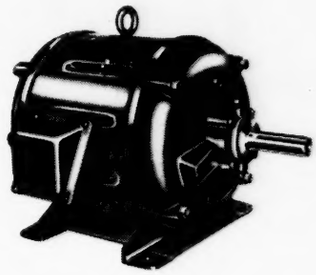
NAME—Model 20N30 Dustkop.
PURPOSE — Self-contained portable dust collector designed for handling dust and dirt from cutting,



grinding, and other machining operations.
FEATURES—There is a direct connection from the outlet of the cyclone separator to out-of-doors. Unit consists of a self-clearing paddlewheel fan direct driven by a 3-hp continuous duty motor. Units are available with a variety of standard size inlets. The optional sizes include single 7 in., single 6 in., double 5 in., or triple 4 in. Model is said to be able to serve four adjacent grinding, polishing and buffing wheels up to 16 in. diameter in simultaneous operation.
OPERATION — Dust and dirt drawn into the unit are removed by the cyclone separator and deposited in the removable drawer in the dust bin. Clean air passes out through the outlet at the top of the cyclone where an 8-in. flange permits a slip-fit connection with standard sheet metal pipe. Unit is placed behind or near the source of dust with the starter circuit being interconnected with the motor of the equipment creating the dust. This assures operation of the dust collector at all times when dust is being created.
SIZES AND CAPACITIES—2300 cfm with 8600 fpm velocity and 4.5 in. static suction on 7 in. pipe. Unit measures 22 by 40 in., with overall height of 56 in.
MADE BY—*Aget-Detroit Co., Main at Washington St., Ann Arbor, Mich.* **13**

Motor

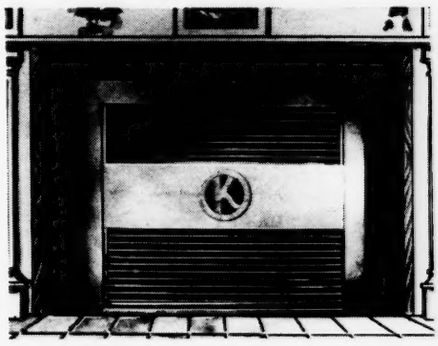
NAME—Wagner drip-proof motor.
PURPOSE—Drip-proof design motor.
FEATURES — Drip-proof design for polyphase motors available in 254, 284, 324 and 326 frames. Frames are formed of heavy rolled steel shaped to accurately center a stator core and to provide passages between the frame and the core for ventilation. An auxiliary fan, larger in diameter than the armature of the motor, draws in air through the openings of the front end-plate, forces it through these passages and then out through the end-plate openings on the drive end. Screens on the end-plate openings prevent foreign



materials from being drawn into the motor. Illustration shows a 5-hp ball bearing motor in a 254 frame.
MADE BY—*Wagner Electric Corp., 6400 Plymouth Ave., St. Louis 14, Mo.* **14**

Fireplace Furnace

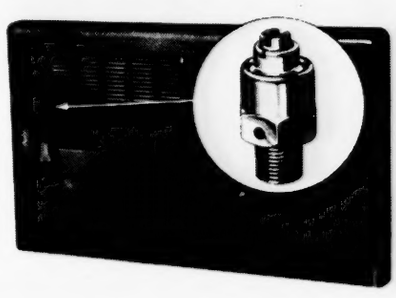
NAME—Kresky fireplace furnace.
PURPOSE—For converting a fireplace into a source of steady heating.
FEATURES—Casing fits into the fireplace opening with an oval hole on top of the casing for running a stovepipe up the fireplace chimney. The assembly that contains the burner, fans, and heat elements, is fitted into the casing by sliding in on flanged grooves. Front panel has a set of louvers in the lower half and another set in the upper half. Cold air is drawn into the lower louvers and into the forced



air induction oil burner. A blower is used to supply the proper amount of air for consumption. Furnace is constructed of heavy gage steel and the circulating fan operates in a noise-free mounting.
SIZES AND CAPACITIES—Two models, one to deliver 40,000 Btu per hr and the other 60,000 Btu per hr.
MADE BY—*Kresky Manufacturing Co., Petaluma, Calif.* **15**

Air Valve

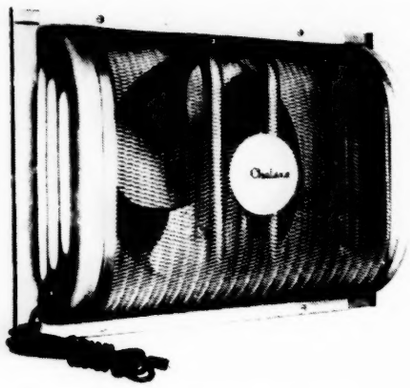
NAME—Dole automatic air valve.
PURPOSE—Fully automatic air valve to eliminate air from convectors, radiators, baseboard radiators, mains, and panel heating units.
FEATURES—A positive setting is quickly achieved by means of



a screw driver; a choice of three different functions is available by a selector screw. (1) Fully automatic air eliminator. (2) Manual shut off. (3) Manual venting.
MADE BY—*The Dole Valve Manufacturing Co., 1933 Carroll Ave., Chicago 12, Ill.* **16**

Window Fan

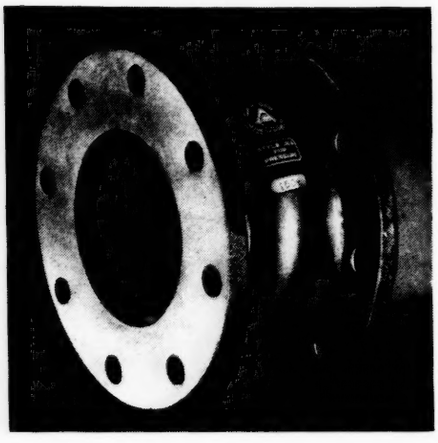
NAME—Chelsea type WP adjustable panel window fan.
PURPOSE — Ventilation for offices, homes and apartments.



FEATURES—Panels fit window openings from 25 to 36 in. A 16-in. fan delivers 1550 cfm and a 20-in. fan delivers 2100 cfm. Both fans are provided with a 1/15 hp motor. A three-speed control enables selection of air volume. Fan is direct-connected to motor. Ratings are in accordance with the Standard Test Code of the Propeller Fan Manufacturers' Association.
MADE BY—*Chelsea Fan & Blower Co., Inc., 1206 Grove St., Irvington 11, N. J.* 17

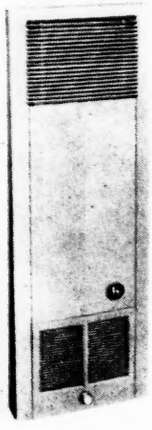
Expansion Joints

NAME—Garlock rubber expansion joints.
PURPOSE—For installation in pipe lines to relieve stresses and strains in piping and equipment.
FEATURES — Units are spool-type joints made of a rubber compound combined with plies of cotton duck. The joint is further reinforced with steel wire or rings. Flexibility is provided by a central arch in the body of the joint located in between the two flanges. The arch flexes with expansion and contraction of the piping, thereby absorbing stresses and strains in the line. Flanges of the expansion joint are made integral with the body of the joint. Joints are made for pressure, vacuum, or for pressure and vacuum.
MADE BY—*The Garlock Packing Co., Palmyra, N. Y.* 18



Wall Heater

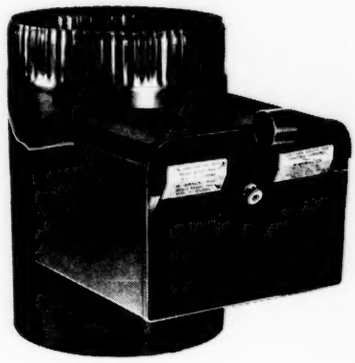
NAME—Holly single wall heater model 25.
PURPOSE—Space heating.
FEATURES—Heater fits into standard 4-in. walls with studs on 16-in. centers. Louvers hide all internal heating elements and direct heat into the room. Panel face always remains cool. A safety shut off valve, completely automatic, is part of the equipment. Unit is available for natural, manufactured or liquid petroleum gas.



MADE BY—*Holly Manufacturing Co., 875 So. Arroyo Pkwy, Pasadena 2, Calif.* 19

Draft Control

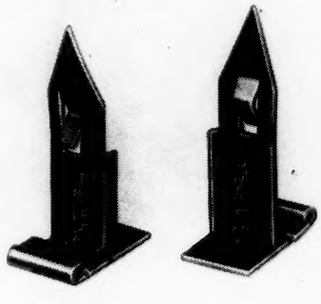
NAME—Type U Windmaster draft control.
PURPOSE — Automatic control of draft adjusted to operating conditions.
FEATURES—A square or rectangular body construction is used which is said to have 27.3% more area than a circle of equal diameter. Greater intake area than a corresponding round opening is provided. The vane is mounted at an angle to the area of the flue. Closed position of vane is at angle to axis of flue. Vane has small rotative arc. Adjustments are made by positioning a weight.



MADE BY—*Skuttle Mfg. Co., 4099 Beaufait Ave., Detroit 7.* 20

Sheet Metal Clip

NAME—Lexsuco insulation clip.
PURPOSE — For attaching insulation to sheet metal.
FEATURES—Clip consists of sharply pointed, hardened and tempered steel shank with a flat head. The slightly rounded shank provides strength for driving. Two shoulders prevent penetration beyond the thickness of the insulation and the special lock, stamped into the shank, locks the clip securely in place. Makers claim the pointed shank will penetrate any metal thickness up to 18 gage. Four clips, it is claimed, are all that is required to hold a 2 by 4-ft sheet firmly in place.
MADE BY—*Lexington Supply Co., 107 Lexington Ave., Cleveland, Ohio.* 21



Aluminum Fittings

NAME—Tube-Turn aluminum welding fittings.

PURPOSE — Forged aluminum flanges to help provide an all aluminum piping system.

FEATURES — Flanges are available in alloys 61ST6 or R361T6 and in the following type of flange: welding neck, slip-on, lap joint and blind. In the 150 lb series, these are available in sizes ½ in. through 8 in.

LITERATURE AVAILABLE—Illustrated folder.

MADE BY—*Tube-Turns, Inc., Louisville 1, Ky.* **22**

Pump Motor

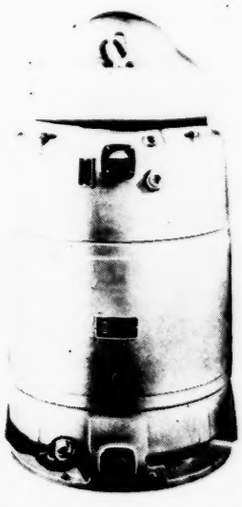
NAME — Verticlosed Streamway motor.

PURPOSE—Vertical pump motor for use in deep wells.

FEATURES—Motor has an interchangeable base to permit increase or decrease in horsepower without the expense of re-machining or exchanging the pump head. A waterproof housing protects vital parts of the motor from injurious weather conditions. Downdraft ventilation prevents re-entry of expelled hot air by blasting the air for about 5 diameters away from the motor. Flush-style oil gages with Lucite windows give full visibility to the oil supply. The lubrication system permits thorough flushing out of all devitalized grease by forcing clean grease through each bearing. An adjustable hollow shaft makes it possible to precisely adjust the impellers of a deep well turbine pump. It also permits the heavy thrust bearing to be placed in the top of the motor and eliminates, it is said, the necessity of using a flexible coupling to connect the motor to the pump shaft. Windings are provided with asbestos protection.

LITERATURE AVAILABLE—Bulletin No. F-1454.

MADE BY—*U. S. Electrical Motors, Inc., 200 E. Slauson Ave., Los Angeles 54, Calif.* **23**

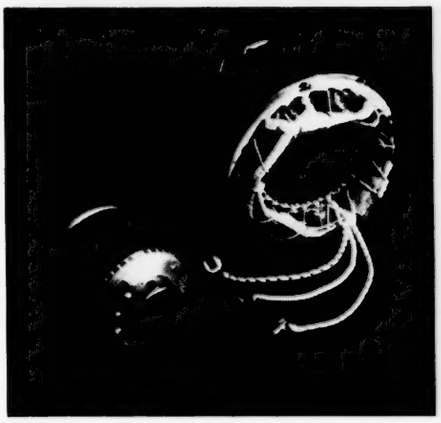


Small Motor

NAME—G-E small-diameter motor.

PURPOSE—For use with hermetically sealed refrigeration compressors.

FEATURES—With a diameter of 4.790 to 4.792 in., motor can be furnished with a rotor having a counterbored quill or with punchings made to fit directly over the shaft. Motor was developed to aid compressor manufacturers in adjusting the size of their units to fit space limitations.



SIZES AND CAPACITIES—In ratings up to ⅛ hp, 1725 rpm, 115 volts, 60 cycles.

MADE BY—*General Electric Co., Schenectady 5, New York.* **24**

Spray Booth

NAME—Dynaprecipitor.

PURPOSE—To remove overspray and fumes from spray booths.

FEATURES—Fumes and overspray are carried off through a solid water curtain and treated to five successive scrubbings to remove paint solids and pigment for disposal or reclamation. Because of the thorough washing of the fumes and dilution of the fumes with large volumes of air, atmospheric pollution is said to be reduced to a minimum. Water is constantly recirculated by centrifugal pumps and the only water that is added is the amount required to make up for small evaporaton losses. Exhaust air free from paint passes through moisture eliminator plates before it reaches the exhaust stack. Unit is made in a large variety of stock sizes for ready erection.

MADE BY—*Binks Manufacturing Co., 3114 Carroll Ave., Chicago 12, Ill.* **25**

JANUARY, 1949

TO OBTAIN FURTHER INFORMATION ON NEW EQUIPMENT

On the list below, circle the item number of the equipment in which you are interested, using the number found at the end of each item.

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25			

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NEWS OF THE MONTH

SNOW-MELTING HIGHWAY

uses heat from Oregon hot springs to clear steep 450-ft grade four lanes wide.

A snow-melting highway in the town of Klamath Falls, Oregon, will be heated in bad weather by water heated in an underground hot spring and circulated from a submerged heat exchanger through a network of welded wrought iron pipe laid in the concrete. Four lanes wide, 450 ft long with an 8% grade, this dangerous road area is designed to remain clear and skid-free in all weather by automatically melting up to one inch of snow or one-tenth inch of ice per hour.

The stretch of all-weather heated pavement is on the Dalles-California Highway leading into Klamath Falls from the north. It passes under the Southern Pacific Railway viaduct and a few hundred feet farther crosses an irrigation ditch, thus necessitating a grade 2 or 3% steeper than would be normally used.

Snow melting highway at Klamath Falls, Ore.

Work was started on the road last spring after a ten-inch well had been drilled which struck a good flow of hot water at 390 ft. G. S. Paxson, bridge engineer for the Oregon State Highway Commission developed the idea for the winter-proof highway.

• **HEAT SOURCE.**—The hot well-water itself is not run through the roadway piping. Instead, a coil of two-inch pipe is submerged deep in the well-water, which tests at 190F. In effect, the well serves as a boiler. A pump sends ordinary water and anti-freeze through the well coil, where it is heated or reheated to not less than 160F.

A two-inch pipe runs from the well to the pavement, and then parallel to the road for a distance of about 400 ft. In the pavement slab are embedded 15,000 ft of ¾-in. wrought iron pipe, made up into one grid for each of a series of 30-ft road panels. Each of these 15 panels is connected with the two-inch water main by valves.

The pipe carried a coating of asphalt before being laid in the concrete. Wrought iron was used in the installation because of its resistance to corrosion and because its coefficient of expansion is virtually the same as that of concrete, thus keeping the bond and minimizing the danger of cracking the concrete.

The two-inch main and the series of grids comprise a closed circuit through which heated water is pumped, the valves insuring an even flow of water through each grid. Thus the whole eight-inch slab of road concrete is warmed to snow-melting temperature.

The pump, thermostatically controlled, automatically begins to circulate the water when air temperature drops to freezing and continues to operate until the temperature rises above freezing. Another pump draws water from the well since it loses its heat value as the cool water flows from the road through the heat transfer coils. Hot water then bubbles up from the earth back into the well.

• **POPULAR.**—This type of heating, with a boiler used to heat the water, has been increasingly popular in residential, industrial and business construction. During the past few years it has been brought outdoors in many installations to winter-proof sidewalks, airports, private driveways and filling station areas. A private road was opened last winter at Belmont, Mass., near Boston, and the American Cyanamid Company plant at Bridgeville, Pa., has a 600-ft two-lane driveway protected by embedded wrought iron pipe coils.

• **NATURAL HEAT.**—The natural hot water at Klamath Falls in southern Oregon is widely used by the residents. It has been tapped to heat 400 homes, a swimming pool, two hospitals, a high school, a new office building, several apartment houses, business buildings, and a newly-constructed $3,000,000 veterans hospital. It is used for sterilizing dairy and soft-drink bottles. Ranchers outside of the town use it to heat their poultry sheds and greenhouses and to warm drinking water for their stock.

The town enjoyed hot mineral springs, once used by the Indians, until they dried up after the San Francisco earthquake of 1906. Geologists believe the water is heated either by hot underground lava or by chemical action.

WARM AIR RESEARCH

reviewed at annual meeting. Professor Konzo honored as he leaves active direction after 19 years.

Professor Seichi Konzo of the University of Illinois College of Engineering, leaving active direction of the warm air heating research work there after 19 years with it, was honored at the recent December meeting of the National Warm Air Heating and Air Conditioning Association in Cleveland. Professor

Konzo is now giving his attention primarily to graduate teaching, while continuing as advisor on heating research.

Robert W. Roose is heading the four-man team carrying on warm air studies, a part of 12 men giving full-time to heating research at Illinois, while Professor Konzo is among five members of the University heating engineering staff whose attention is primarily on teaching, but who also help with research.

• **RESEARCH PROGRAM.**—The NWAHAC research program, inaugurated in 1918, is carried on at three separate locations on the campus of the University of Illinois. These are: (a) the warm air research residence: (b) the university Small Homes Council research residence; and (c) the mechanical engineering laboratory.

In the warm air research residence during 1948, there have been conducted studies of a forced warm-air convection heating system and a warm-air ceiling panel heating system. This is the first full year in which the new warm air research residence has been used for heating study. It is the second such residence to be built by the association for research purposes.

A draft of the Engineering Experiments Station Bulletin on the 1947 and 1948 heating season tests in the residence has been completed and reviewed by the panel heating sub-committee of the association's research advisory committee. The report, consisting of a comparison in the performance between the conventional forced warm air system and the ceiling panel system as demonstrated in these tests, will be released for publication within the next few weeks.

During the 1947 and 1948 heating season a gravity warm-air extended plenum system has been tested in the Small Homes Council research residence. The reports of results thus far obtained will appear in an Engineering Experiment Station circular. Meanwhile, tests will be continued through the 1948 and 1949 season under conditions more accurately simulating average basement height.

Three tests have been under way at the Mechanical Engineering Laboratory; a furnace-blower performance project, an extended plenum fittings study, and a study of the balance of air distribution in a duct system. These testing projects will be continued on into 1949.

• **TWO NEW RESIDENCES.**—Supplementing the re-research program already being conducted, the association's board of directors has authorized the immediate construction of two new research residences together with an instrument shed to be erected on lots adjacent to the present warm air research residence. It is intended that these houses will be made ready for research investigation during the heating season of 1949-50.

In one house, the association will conduct tests of low cost heating systems to be selected by the newly created Low Cost Housing Heating Committee and to effect improvements in the design, installation and operation of this system.

In the other new research residence tests will be made of gravity furnace operation and various types of wall heating appliances for comparison purposes.

ASRE ANNUAL CONVENTION

at Washington, D. C., elects B. H. Jennings, president. Program includes four technical sessions.

Eight hundred members and guests of the American Society of Refrigerating Engineers attended the society's 44th annual convention held at the Statler Hotel, Washington, D. C., December 5-8.

C. M. Ashley, Chairman of the Program Committee, arranged for four technical sessions, plus a special domestic refrigerator engineering conference in charge of George K. Iwashita. The fourth and final session of the convention was devoted to papers on frozen foods.

• **WELCOME LUNCHEON.**—Earl O. Shreve, president, United States Chamber of Commerce and a former vice president of the General Electric Co., was the speaker at the welcome luncheon, Monday, December 6. He called attention to the fact that the industry had failed to obtain its share of recognition which would have followed if the public were acquainted with all the outstanding developments in the field, and the advancements in industry made possible through refrigeration.

• **PAPERS.**—Following are the engineering papers presented, exclusive of those devoted to food preservation:

Ideal Specifications for Absorbent-Refrigerant Combination, R. M. Buffington, Servel, Inc., Evansville, Ind.

Dynamic Analysis of High Speed Compressor Valves, E. S. Bishop, York Corp., York, Pa.

Equilibria in Freon-12 Water Systems, L. C. Flowers and H. M. Elsey, Westinghouse Electric Corp., Springfield, Mass.

Inherent Motor Protection for Hermetically Sealed Compressors, B. O. Haun, Spencer Thermostat Co., North Attleboro, Mass.

Pressure Drop With Change of Phase in Capillary Tube, G. P. Marcy, Westinghouse Electric Corp., Springfield, Mass.

Theory and Use of Capillary Tube Expansion Device, M. M. Bolstad and R. C. Jordan, University of Minnesota, Minneapolis, Minn.

Ultra Rapid Cooling and Preservation of Life, B. Luyet, St. Louis University, St. Louis, Mo.

Further Tests on New Ice-Salt Mixtures for Railway Refrigerator Cars, W. H. Cook and J. M. Carbert, Canadian National Research Laboratories, Ottawa, Canada.

Economical Use of Condenser Water, A. P. Boehmer, University of Iowa, Iowa City, Ia., and Leon Buehler, Jr., Creamery Package Mfg. Co., Chicago, Ill.

• **INSPECTION TRIPS.**—Inspection trips were arranged on Monday afternoon to the Pentagon Building, Arlington, Va.; National Bureau of Standards, Washington, D. C.; the U. S. Naval Research Laboratories, Bellevue, D. C.

• **AWARDS.**—The annual Wolverine award went to Lloyd A. Staebler, Universal Cooler Division, International Detrola Corp., Marion, Ohio, for his paper on capillary tubes.

The ASRE $50 prize for the best paper presented before a section was awarded to D. D. Wile, Chief Engineer, Refrigeration Engineering Co., Los Angeles, Calif., for his paper before the Dallas-Fort Worth Section.

• **OFFICERS.**—The new officers of the association are Burgess H. Jennings, chairman, Department of Mechanical Engineering, Northwestern University, Evanston, Ill., president; John G. Bergdoll, Jr., York Corp., York, Pa., vice president; Edward Simons, consulting engineer, Los Angeles, Calif., vice president; Paul B. Christensen, chief engineer, Merchants Refrigerating ing Co., New York City, treasurer; M. C. Turpin, secretary.

• **NEW BUSINESS.**—The association accepted the proposal of the Spencer Thermostat Co., North Attleboro, Mass., that the company be granted permission to provide an award for the best paper to be presented on the subject of hermetically sealed motors and their protection. Funds are provided for about five awards.

The association also decided to continue its publication *Refrigeration Abstracts*, but where possible to eliminate the abstracting of papers directly outside of the field in order to reduce publication expense.

• **COMING CONVENTIONS.**—The spring convention will be held June 5-8 on the Steamer Richelieu which will sail from Montreal, Canada, for a cruise to the Sageunay River and return to Montreal. The winter convention is scheduled for December 4-7 at the Edgewater Beach Hotel, Chicago, Ill.

HOUSE HEATING TESTS

in Britain complete first season. Report shows central heating with insulation most economical.

The Building Research Station of Britain's Department of Scientific and Industrial Research has been conducting experiments in the heating of homes. A first report of the trials has now been published: "The Economics of House Heating," by Richard Eve and J. C. Weston, in the November 1948 issue of the *Journal of the Royal Institute of British Architects.*

• **20 HOUSES.**—The experiments have been carried out in twenty specially-built houses at Abbots Langley, in Hertfordshire, England. Nineteen different combinations of appliances for space heating, cooking and domestic hot water supply were installed in them so that the relative economy, efficiency, and amenities of each method of heating might be tested. The twentieth house contained the same appliances as one of the others, to show the difference between the northern and southern house in a semi-detached pair.

There are three groups of houses, two of eight houses each and one of four houses. In the first group, "partial" heating is provided. Here the living rooms are heated by an open fire or a modern "improved" appliance. The kitchens are heated only by the warmth escaping from the cooker or hot-water heater, while the halls, bedrooms, and bathrooms are unheated. The second group is provided with "two-stage" heating. In this group the whole house is supplied with background heating, usually by convected warm air, and when the room is to be used, the topping-up heating is provided by radiant fires. In the third, or "whole-house" group, the four houses are fully heated by central systems.

• **FIRST TRIALS.**—The first of the two phases of the trials has now been completed. In this phase, the houses were furnished but not occupied. The tests were made by laboratory staff according to a routine based on the life of a typical family of four. The routine included such things as the frequency with which the hot water was used and fires made up.

The second phase is now in progress. Families are living in the houses, and the same series of tests is being made. These include, among other aspects, recording air temperatures inside all rooms, the rate of air movement through the house, the quantity of hot water drawn, and the quantity of fuel used for each appliance. Also recorded automatically is the opening and closing of every door and window. A final report will be made when the second phase is completed.

• **INSULATION.**—Some interesting conclusions already arrived at are given in the first report. The importance of thermal insulation was clearly demonstrated. The houses were all built to a good standard of thermal insulation to minimize the loss of heat through the walls and roof. The experiments showed that the houses did not cool down during the night nearly as much as had been expected—even where the only space heating appliance was an open fire in the living room. It had been expected that the temperatures of 45F to 50F would be experienced, but even in the worst heated house they did not drop out of the range of 50F to 55F except during a week of freezing weather, when some of the unheated bedrooms approached temperatures of 45F. In the houses with improved heating systems higher temperatures were recorded.

• **INFILTRATION.**—Doors and windows were kept shut during the first phase. Nevertheless, it was found that the houses received more than the amount of fresh air considered necessary for healthy living conditions. External doors were loose fitting and were weather-stripped or "draught-proofed" with a patented metal strip. Even after this had been done, there was more than sufficient air entering the houses through the air ducts, and the cracks around doors and windows.

• **FUEL.**—The fuel consumptions for a whole year

FOR EASY BENDING
USE REVERE COPPER WATER TUBE

YOU can install radiant panel heating coils easily and quickly with Revere Copper Water Tube. For this tube is readily bent by hand, with simple wood templates providing the proper radius and spacing. (Details for constructing a bench suitable for forming radiant heating coils will be sent to you upon request.)

Where joints are needed, they are speedily made with solder fittings. And you can handle the 60-foot lengths of this tube easily because of its relatively light weight.

In radiant panel heating, just as in water supply and other types of heating systems, *trouble always costs more than Revere Copper Water Tube.* The permanently smooth interior of this tube reduces frictional resistance to a minimum. It is highly resistant to corrosion attack from water in the heating system; hence rust accumulation is eliminated. And the coefficient of expansion of Revere Copper Water Tube is almost identical with that of plaster, which is an important advantage in wall and ceiling installations.

It will also pay you to install such other long-lived Revere materials as Red-Brass Pipe; Sheet Copper and Herculoy for tanks, ducts, pans and trays; Dryseal Copper Refrigeration Tube (dehydrated and sealed); Copper oil burner, heat control and capillary tubes.

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have been worked out, including space heating, cooking, and supply of hot water. The calculations were based on the data obtained last winter (1947-48), which was nearly a typical British winter. The fuels consumed (gas, electricity, bituminous and anthracite coal) have been priced on the basis of prevailing prices in the London area in April 1948.

• **CENTRAL HEAT.**—The houses with complete central heating were among the cheapest to run, when all factors had been considered. For example, they were much cheaper to run than the combination of an open fire and an independent boiler, and also compete successfully with closeable stoves or improved versions of the open fire. One disadvantage of central heating was the need for graded anthracite, which is not freely available in Britain. Including all the items necessary for a central heating system, the installation cost is more than twice as great as that of the open fire with back boiler. A study of relative costs showed, however, that when the capital and annual costs were spread out over a period of years, and added to fuel costs, central heating schemes dropped into the middle group, neither the cheapest nor the most expensive.

Convected warm air is being used for heating in some of the houses. Trials so far are indecisive because tenants can readily modify the way in which the system works. The tenants now in the houses will be a valuable help because they will indicate which rooms they like to use and keep warm, and which are kept at lower temperatures in order to cut the costs.

• **TIME STUDY.**—With the housewife in mind, a study has been made of the comparative time taken to tend the appliances in each house. This includes the time needed for carrying fuel from storage, and for cleaning grates and stoves, but not for dusting and polishing the actual appliances. It includes tending the cooker, but not cooking. Thus far, the best system has proved to be a gas or electric cooker in a centrally heated house, for which the total time needed was 65 minutes a week. The worst system was in the house with an open fire in the parlor and a combination grate in the kitchen-living room. Time needed for the latter house was 205 minutes a week.

POWER EXPOSITION

marked by innovations in equipment and materials to meet new design trends.

The 18th National Exposition of Power and Mechanical Engineering, held in Grand Central Palace, New York, November 29 to December 4, was notable for the number of equipment innovations displayed there. Equipment displayed on the four floors of the Palace reflected the second great wave of improvements released since the end of the second world war.

• **MODELS.**—One of the most interesting of the displays was the model of the new generating station of the Pennsylvania Power and Light Co., now nearing completion at Sunbury, Pa. This model, built to a scale of one-quarter inch to the foot, is a complete miniature of the first unit in an entirely new plant which will have an eventual capacity of 500,000 kw. This will be the largest plant in the world burning pulverized anthracite. The first unit is of 150,000 kw capacity and its construction incorporates practically every type of equipment on exhibition at the Palace.

Of similar interest was a transparent plastic model of a tropical power plant to be erected in Guatemala. This plant incorporates a special water treating plant as a part of its design. At a third booth was a scale model of a power station, built to show the location, type and relative size of every valve.

Especially noteworthy were several new sectional and working models carrying further than heretofore the replacement of structural materials by transparent plastics to show the operation of internal parts, or the flow of materials. The latter purpose was exemplified in a complete plastic model of a dust-collecting system and also in a model of an electrostatic dust collector having a transparent face. A third transparent model showing fluid movement was a deaerator.

• **INTENSIFICATION.**—Progress in the mechanical engineering of power plants during the past few years has been accomplished principally through intensification, that is, the stepping-up of fluid pressures, hence increasing velocities of flow and, in the case of steam and processing in general, raising temperatures. Typical pressures in today's steam plants run from 800 to 1400 lb per sq in., and temperatures are in the range of 950 to 1050F.

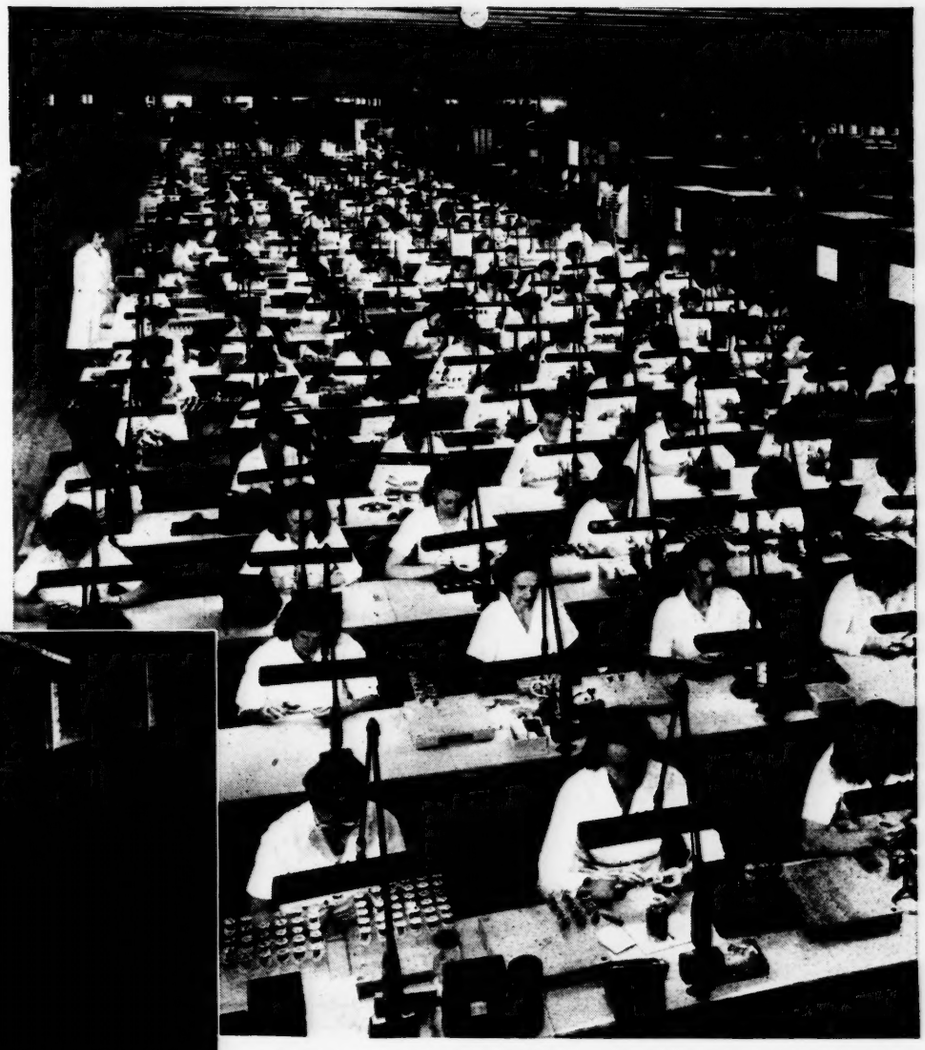
These elevated values have necessitated revision of design, which, in many instances, has been made possible only by the development of more highly resistant materials. One instance was the development of a new line of cast steel valves in which it is said that flow has been increased up to 30% and pressure loss lowered by 40%. There is in the same line a newly designed series of forged steel, integral seat welded bonnet valves for services at 1500 to 2500 lb per sq in. at 1000F. The entire line is fabricated from chrome-molybdenum steel.

Even small devices in numerous instances reflect complete change. A newly developed ring packing consists of a synthetic rubber sealing ring supported on both sides by rings of laminated phenolic material. The new and widely publicized "cold rubber" appeared in a new V-belt drive, in which the high wear resistance of this material was said to prolong belt life.

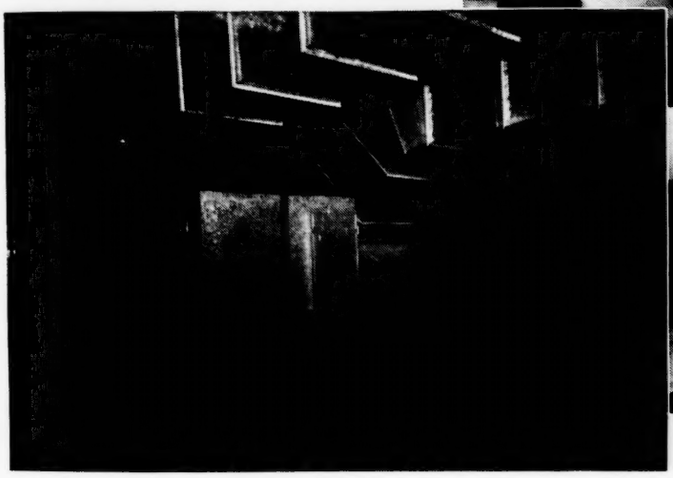
One manufacturer disclosed a new line of tube type, totally enclosed, fan-cooled motors, so thoroughly protected that they are suitable for outdoor use, and so thoroughly ventilated that they may be operated under exposure to heavily dust-laden atmospheres without the tubes being clogged or the windings fouled. Because of the efficient ventilating and heat transfer system incorporated in the design, these motors are only slightly larger than standard open motors of

NO DUST AFLOAT

IN THIS ELECTRONICS PLANT



Four miles of these ducts carry 750,000 cfm of conditioned air through Western Electric's Allentown Plant. Ductwork was installed by Lehigh Engineering Company, Bethlehem.



In this room where parts for vacuum tubes are assembled by hand, control of temperature, humidity, and air pressure is required.

A speck of dust in the air or a trace of perspiration on a finger can do considerable damage to the intricate parts of a modern vacuum tube. Atmospheric conditions have to be near perfect in factories where such complex electronic devices are made.

At the new Allentown, Pa., plant of the Western Electric Company, manufacturing unit of the Bell System, for example, the air is completely conditioned and controlled to maintain the high quality of this company's electronic products. Temperature and humidity are closely controlled throughout the year. The interior of the building is slightly pressurized like an airplane cabin to prevent outdoor air and dust from leaking in.

The air-conditioning system for a plant such as this takes a multitude of equipment and materials. Among the materials of interest to sheet-metal contractors are the Beth-Cu-Loy (copper-bearing) Galvanized Steel Sheets used for the ducts on this job. Beth-Cu-Loy sheets have high resistance to corrosion . . . they are easy to handle, cut, seam and solder . . . they cost very little more than ordinary galvanized steel sheets.

Beth-Cu-Loy
GALVANIZED
Steel Sheets

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equivalent rating. On view was a 600-hp unit operating on 2,300-volt current.

• **WATER TREATMENTS.**—Greatly intensified by the higher pressure-temperature-velocity phases of current design is the formation of sludge, scale and slime in boilers and heat exchangers, and a consequent increase in the difficulty of treating process water.

A test condenser was exhibited in which were 16 test tubes, each of a different copper alloy for comparing the effect of sea water on the metal under accelerated operating conditions.

One of the petroleum companies came up with a portable electronic instrument which when pulled through a tube will chart the condition of the metal, positively locating such defects as pinholes and scale.

One point of attack on the problem of boiler corrosion is the elimination of dissolved oxygen by heating above the boiling point and then diffusing the water through a series of fine sprays or by bottling. Another is demineralization, which several manufacturers accomplish by chemical means through the use of suitable mechanical equipment. The ion exchange method of demineralization was illustrated by a model of the largest plant of its kind, which has a flow rate of 2,000 gallons per minute of make-up water to high pressure boilers in the plant of a midwest chemical manufacturer.

The manufacturer of an "electronolytic descaler," whose method is an adaptation of the familiar principle of electrolysis, is newly offering an application of the same type of cartridge that is used in boilers as a means of preventing clogged jackets in Diesel engines.

• **PACKAGED UNITS.**—There has been a definite increase in the development of packaged boiler units in the field of power applications. These are produced with all accessory equipment, ready to set down on the job and connect up. At the Palace not less than eight different units of this general description appeared, ranging from a small steam cleaning unit to packaged boilers of several hundred horsepower capacity. In this group appeared an entirely new type of electric boiler, in which steam is generated by the flow of electric current through the water. In this unique boiler current flows only through the submerged portion of the electrodes, so that the height of the water in the open shell determines the rate of the steam generation. Automatic control is provided by a pressure regulator. When the regulator has been set, a rise in pressure above the predetermined maximum closes a valve and prevents admission of water. As steam is used, the water level then falls, reducing submerged portion of the elements, cutting down the heat supply and causing a pressure drop. Reduced pressure, in turn, opens a valve communicating with a surge tank which is in circuit with the boiler, permitting more water to enter, raising the level in the boiler and permitting more steam to be generated.

• **CONTROLS.**—Instruments and control systems at the exposition included a number of innovations, such as a four-pen recorder which registers differential pressure, two temperatures and speed. The exhibitor of this instrument also has brought out a new oxygen recorder for use instead of the more conventional CO_2 recorder for measuring combustion efficiency.

A new type of smoke density recorder uses a sealed-beam light source and a highly sensitive filament, the temperature of which depends on radiation. Smoke, fumes or dust-laden atmospheres between the light source and the filament determine the amount of radiation reaching it. The filament temperature, as measured by an electronic recorder is then recorded in terms of atmospheric density.

Specialized applications of automatic controlling and recording functions are found in such new apparatus as a belt conveyor for powders and granular substances which gives a continuous record of weight handled, which may be integrated with proportionate feeding hoppers, where mixtures are to be compounded, which has a batch cut-off feature for optional use, and which has connections with some remote signals, indicators and recorders, as the job may prescribe. Proportioning pumps perform similar services with respect to liquids. One is especially arranged for feeding high-pressure boilers, at the same time feeding the necessary minute quantity of chemicals.

Materials handling gained new facilities this year, in a horizontal spring mesh belt conveyor that turns corners, and also in a "zipper" conveyor-elevator, which operates as a flat belt or a tube, as may be required.

The exposition, as in previous years, was under the management of the International Exposition Company; Charles F. Roth, manager; E. K. Stevens, associate manager.

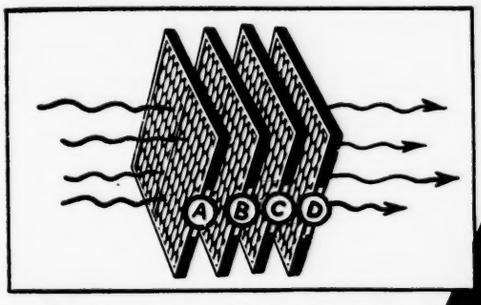
REFLECTIVE INSULATION

to be tested in experimental house at the University of Cincinnati.

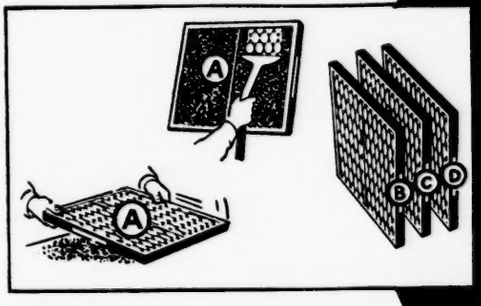
The College of Applied Arts at the University of Cincinnati will design and erect an experimental residence adapted to a system of reflective radiant conditioning tested under laboratory conditions ten years ago by Dr. Clarence A. Mills, Professor of Experimental Medicine in the University's College of Medicine.

It was noted that reflective radiant conditioning was not to be confused with radiant heating. Wall and ceiling surfaces are to be of embossed aluminum foil serving as heat ray reflectors. In place of a heating plant there will be a few electrical resistance coils in each room for generating heat rays. The idea is to heat and cool the structure through radiant channels almost exclusively with little or no concern for air temperature or humidity. Dr. and Mrs. Mills will live in the experimental residence to make observations and keep records.

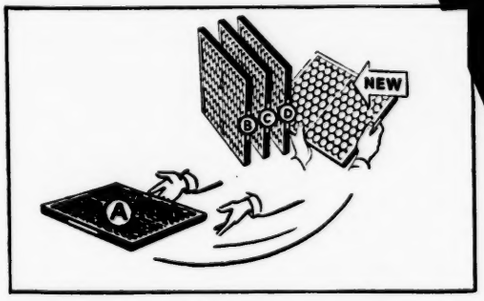
DOWN



1. Use four (or two) 1" DUST-STOP Filters in each frame cell.



2. Rap out or vacuum upstream filter as required, to reduce face loading.



3. When resistance calls for replacement, discard upstream filter and insert new DUST-STOP Filter in rear.

Cut air filtering costs in central systems with one-inch DUST-STOP Air Filters and the progressive replacement plan! High efficiency. Easy maintenance. Simple as 1-2-3. See diagrams at left.

DUST-STOP Air Filters and DUST-STOP metal frame assemblies, available everywhere, enable you to design filter panels for all space and air volume requirements. Complete details are given in folder D48-7. Write for it today. Owens-Corning Fiberglas Corporation, Toledo 1, Ohio.

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GAS INDUSTRY

establishes new records in 1948. Sales, revenues, and natural gas reserves increase.

Despite continuing shortages of steel and other vital materials which have retarded the planned expansion of its production and distribution capacity, the gas industry established several new records in 1948. More customers were served with gas than ever before. Output of gas attained a new high level, gas utility revenues reached an all-time peak and capital expenditures for construction and expansion of gas utility systems surpassed any previous figure in the history of the gas industry, according to Robert W. Hendee, president of the American Gas Association.

New records were set in the sale of gas refrigerators and automatic ranges. Recently developed appliances broadened sales of gas in new domestic fields such as automatic gas laundry drying, gas incineration and all year gas air conditioning. A gas heat pump using latent heat in earth or water as as source for house heating was one of the year's outstanding developments.

• **STATISTICS.**—At the end of 1948 the gas utilities were serving 22,689,800 customers, including LP customers served directly by utilities, an increase of 4.1% over 1947. Of this number 12,242,500 were receiving natural gas, a gain of 13.3%; 8,369,000 were receiving manufactured gas, a decrease of 2.3%, and 1,756,200 customers were served with mixed gas, a decline of 19.6%. Approximately 320,000 customers received LP gas directly from utilities. Decreases in the manufactured and mixed gas customer groups are attributed to changeovers of important companies to straight natural gas during the year. In addition it is estimated that more than 4,500,000 customers are being served with LP gas in territories not served by gas mains.

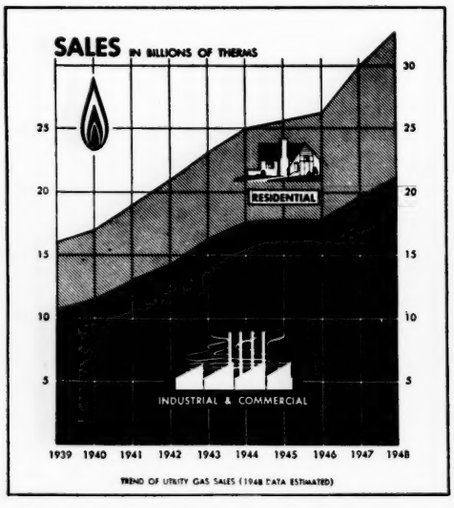
Utility sales of natural gas during 1948 were 2,802,079,200 Mcf an increase of 11.4% over 1947. Manufactured gas sales amounted to 447,320,400 Mcf, a gain of 3.0% and mixed gas sales declined 15.1% to total 146,173,400 Mcf.

• **NEW FACILITIES.**—Utilities spent approximately $875 million last year in the expansion of production, transmission and distribution facilities, a figure which surpassed the previous record of $800 million spent in 1947. The increase in 1948 is especially noteworthy when it is remembered that the 1947 figure included $143 million for the purchase of the Big Inch and Little Big Inch pipelines from the government.

Forecasting a continuation of this tremendous demand for gas, the industry has estimated its capital requirements for construction and working capital for the five year period 1948-1952 at $3.3 billion, with more than 90% of this amount to be expended for the construction of new facilities.

• **NATURAL GAS EXPANSION.**—The Federal Power Commission, during the year, authorized the construction of approximately 8,500 miles of new pipeline, bringing the total of natural gas pipelines in the United States to about 251,330 miles. The magnitude of this great system can be better appreciated when it is pointed out that today's natural gas pipeline system exceeds the railroad mileage in the nation by 17,000 miles and exceeds the oil pipelines by more than 100,000 miles. In addition to projects already approved, applications pending before the Federal Power Commission total an additional 14,600 miles. The largest single authorization by the Commission was for construction by the Trans-Continental Gas Pipe Line Company of a 1,840-mile pipeline from Texas to New York City at an estimated cost of $189 million.

Proved natural gas reserves continue to gain despite the increased yearly consumption and hold every promise of being adequate to meet the potential demand for many years to come. The Reserves Committee of the American Gas Association estimated that the proved recoverable reserves at the beginning of 1948 totaled 165.9 trillion cubic feet compared with 160.6 trillion cubic feet at the beginning of 1947. Although 5.6 trillion cubic feet were produced during 1947, new discoveries and upward revisions of reserves in proved fields continue to exceed the rate of production and consumption of natural gas.


SALES IN BILLIONS OF THERMS
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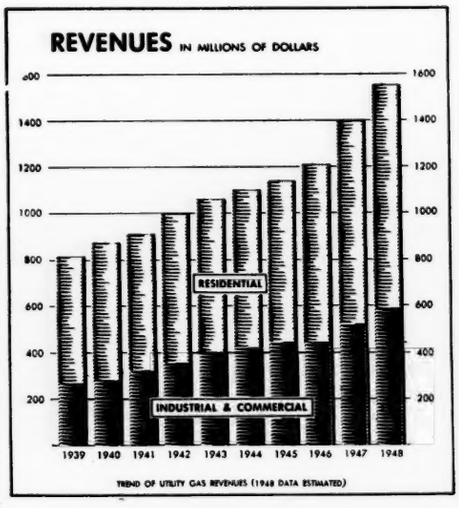
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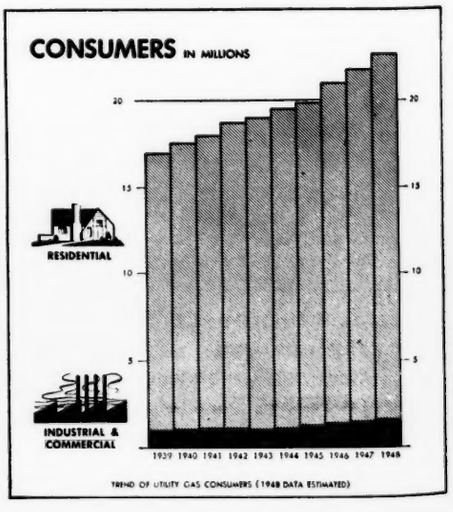
TREND OF UTILITY GAS REVENUES (1948 DATA ESTIMATED)


CONSUMERS IN MILLIONS
RESIDENTIAL
INDUSTRIAL & COMMERCIAL
1939 1940 1941 1942 1943 1944 1945 1946 1947 1948
TREND OF UTILITY GAS CONSUMERS (1948 DATA ESTIMATED)

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TECHNICAL KNOW-HOW

exported along with air conditioning and refrigeration equipment as international student groups complete training at Harrison works.

The Class of 1948-49 in Worthington Pump and Machinery Corp.'s international student training program is winding up training at the corporation's Harrison works and will shortly be sent to Buffalo, Holyoke, and other Worthington plants for further training.

International students get instruction on dairy plant refrigeration. Left to right, O. B. Wert, Air Conditioning and Refrigeration Division, instructor; Ove Esrum of Denmark; Bharat C. Oza and Hasmukh J. Jhaveri, India; Serge H. Placend, France; Sonthi Keyurovong, Siam.

Discussing the program, A. William Fraser, general European manager of Worthington, who spent the last three and a half years in Europe, told of the effect of American industrial prestige, equipment and production techniques in promoting good will and speeding industrial rehabilitation in Europe.

The corporation's training course in air conditioning and refrigeration equipment includes both foreign and domestic students who have qualified. Graduates will assume duties in various Worthington offices or distributor organizations both here and abroad.

NEWS BRIEFS

• After two years of operation ending September 10, 1948, National Coal Association has negotiated agreements with *49 coal service groups* totalling 1,422 members representing an estimated *13 million tons of bituminous coal* annually. The plan features 24-hour service for consumers by cooperating members within local groups.

• U. S. Geological Survey is embarking on a new and detailed survey of the *coal reserves of the United States.* Survey will take about ten years. Coal reserve figures now in use were assembled in 1928.

• The Producers Council forecast for 1949 predicts a *1% increase in total construction* in the United States. According to the forecast, private construction will drop 4.5% while public construction increases 19.3%. The Producers Council expects substantial gains of hospitals and institutional, military and naval, and public housing construction.

• According to preliminary figures released by the Department of Commerce, shipments of *power driven oil burning equipment* totaled 56,228 in September. This compares with a 1947 September figure of 127,961. It shows an increase of 12% over August, 1948.

• *About 76% of anthracite* consumed in the United States was used *for space heating,* the Anthracite Institute says.

• *Bituminous Coal Research, Inc.,* has authorized research budget of more than half a million dollars for the second consecutive year, exclusive of the programs being conducted by BCR Mining and Locomotive Development committees.

• *Sales of gas ranges,* refrigerators, water heaters and space heaters reached all-time highs in 1947-48, according to the Gas Appliance Manufacturers Association. Sales might have been higher if it had not been for shortages of high grade enameling sheet metal and the lack of steel pipe which prevented expansion of gas service. Sales of residential gas ranges show an increase of almost 20% over 1947. Automatic gas water heater sales totalled 1,500,000 units in 1948. Almost 300,000 gas-fired central house heating installations were made.

• The National Bureau of Standards reports on its seven year test of *weather resistance of porcelain enamel.* Specimens included acid resistant and non-acid resistant enamels. From the standpoint of protection of the metal against corrosion all of the enamels were satisfactory throughout the entire period. With the exception of some full-mat specimens and a few of the deeply colored non-acid resistant enamels, changes in appearance over seven years of exposure were not objectionable.

• Engineers and scientists representing the Smoke Prevention Association of America met in Chicago November 15 to outline steps for *investigating the Donora, Pa., smog disaster.*

• The *First Southern Refrigeration and Air Conditioning Education Conference and Exhibit* will be held at Birmingham, Alabama, February 4, 5, and 6, sponsored by Refrigeration Equipment Manufacturers Association.

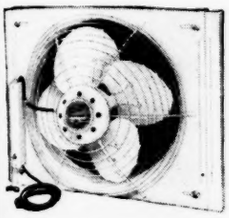
• *A storage-tank construction program* has been completed by the Socony-Vacuum Oil Company, Inc., in more than 25 cities in northeastern United States. The additional tanks have a total capacity of more than 61,000,000 gallons.

FRESH-AIR MAKER FANS

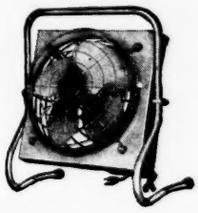
by SCHWITZER-CUMMINS

Builders of Fine Fans for 30 Years

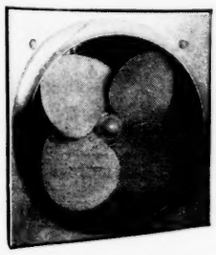
Many useful types in a generous assortment of sizes make the Fresh-Air Maker a profitable and satisfactory line for you to sell. Your trade will like their fine performance—good looks—and reasonable price. All are built to deliver lots of air, quietly, and for long years of service. It will certainly pay you to look into the Fresh-Air Maker.



ADJUSTABLE WINDOW FANS—From a lovely powerful 10" surprisingly low priced, through 12"-16"-20" sizes, single and three speed—many refinements and distinctive features.

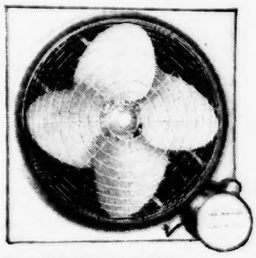


PORTABLE FANS—12", 16", 20"—attractive—quiet—large delivery—three speed—adjustable for any angle. Useful type, suggestive of a lot of gift business.



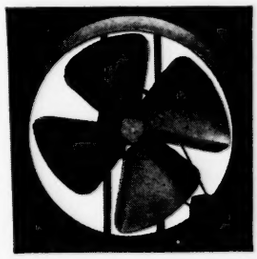
EXHAUST FANS—Direct driven 12"-16"-20" 3 speeds—24" belt driven—capacity range 450 to 4200 cfm.

CEILING "PACKAGE UNITS"—5 models 24", 30", 36", especially designed for the popular small home market. Every Fresh-Air Maker can be ceiling installed, all ball bearing equipped.



24" WINDOW FAN—Locates outside in window frame for a big job in a small home, saving all installation cost—arranged also for attic, ceiling or transom use—distinctive, nothing else like it. 4200 to 4500 cfm.

Contact with good reliable dealers is desired as we have some valuable locations open for distributors or dealers who want a reliable, salable fan line.

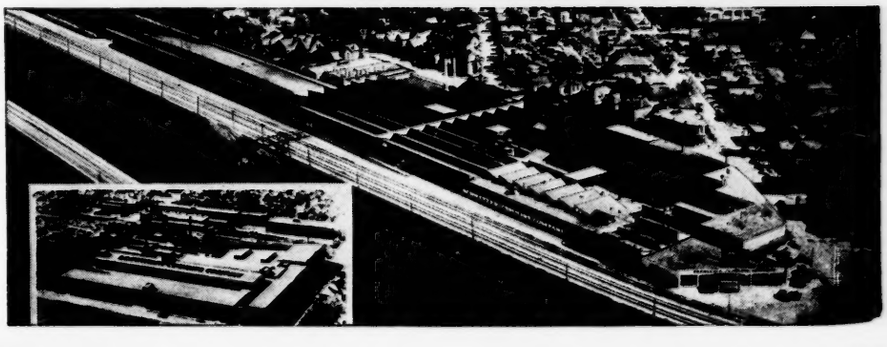


ATTIC FANS—9 models—24", 30", 36", 42", 48"—ruggedly built, a quality look, big volume, belt driven—4200 to 20,500 cfm vertical or horizontal, wide deep blades, extra deep venturi, all ball bearing.

HY-DUTY CENTRIFUGAL BLOWERS—8½" to 25" inc. with all needed intermediate diameters—single and double inlet—all outlet positions and practicable motor sizes—moderately priced, but built to be the quietest, best performing, longest lasting blower on the market—especially well finished.

SCHWITZER-CUMMINS COMPANY
VENTILATING DIVISION
1145 EAST 22nd STREET
INDIANAPOLIS 7, INDIANA
ENGINEERS AND MANUFACTURERS
of Fine Fans for 30 years

AIR HANDLING AT ITS QUIETEST BEST



DEGREE-DAYS FOR NOVEMBER, 1948

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city.

HEATING AND VENTILATING'S 22nd Year of Publication of Monthly Degree-Day Data

City	November			Cumulative, Sept. 1 to Nov. 30			Heating Season[1]
	1948	1947	Normal	1948	1947	Normal	Normal
Abilene, Texas (A)	378	446	333	488	459	333	2061
Albany, New York (A)	598	881	774	1243	1328	1292	6580
Albuquerque, New Mexico (A)	733	734	630	1057	906	903	4298
Alpena, Michigan (C)	701	922	912	1380	1442	1704	8299*
Anaconda, Montana (C)	1083	1118	951	1999	2026	1933	8357**
Asheville, North Carolina (C)	423	602	276	799	808	852	4232
Atlanta, Georgia (A)	310	492	396	474	548	492	2890
Atlantic City, New Jersey (C)	375	573	588	683	758	842	5176
Augusta, Georgia (C)	173	367	321	297	401	337	2161
Baker, Oregon (C)	954	929	849	1765	1607	1659	4533
Baltimore, Maryland (C)	363	561	567	656	730	790	7163
Billings, Montana (A)	863	1025	909	1432	1618	1622	7119
Binghamton, New York (C)	562	845	798	1176	1212	1359	6808
Birmingham, Alabama (A)	321	443	318	479	472	318	2352
Bismarck, North Dakota (A)	1006	1242	1113	1691	1915	1961	9192
Block Island, Rhode Island (C)	430	620	573	807	909	852	5788
Boise, Idaho (A)	839	864	738	1388	1319	1274	5552
Boston, Massachusetts (A)	461	715	693	878	1016	1104	6045
Bozeman, Montana (C)	1053	1141	1006	1860	1952	1993	8521**
Buffalo, New York (A)	536	810	774	1107	1167	1268	6822
Burlington, Vermont (A)	619	925	861	1361	1424	1486	7514
Butte, Montana (C)	1114	1220	923	2104	2168	1922	8235**
Cairo, Illinois (C)	439	584	519	661	675	677	3909
Canton, New York (C)	632	944	906	1394	1492	1652	8020
Charles City, Iowa (C)	805	1052	936	1341	1424	1505	7588
Charleston, South Carolina (C)	86	244	207	173	256	207	1769
Charlotte, North Carolina (C)	280	496	426	482	602	541	3120
Chattanooga, Tennessee (A)	391	495	426	628	564	531	3118
Cheyenne, Wyoming (A)	1017	1084	900	1739	1679	1745	7466
Chicago, Illinois (C)	608	854	696	964	1074	1098	6077
Cincinnati, Ohio (C)	456	653	615	794	811	869	4684
Cleveland, Ohio (A)	541	811	732	1080	1084	1125	6155
Columbia, Missouri (C)	576	721	651	886	842	911	4922
Columbia, South Carolina (C)	185	389	324	326	439	355	2364
Columbus, Ohio (C)	510	733	690	935	933	1003	5398
Concord, New Hampshire (A)	680	916	846	1410	1464	1498	7353
Concordia, Kansas (C)	711	815	693	1032	973	969	5315
Dallas, Texas (A)	318	412	303	385	421	303	2256
Davenport, Iowa (C)	681	915	795	1088	1147	1158	6289
Dayton, Ohio (A)	573	807	660	1080	1052	933	5264
Deer Lodge, Montana (C)	1026	1098	1055	2071	1973	2187	8672**
Denver, Colorado (C)	787	903	759	1202	1250	1259	5874
Des Moines, Iowa (C)	708	914	798	1110	1174	1155	6384
Detroit, Michigan (A)	580	835	777	1116	1163	1219	6490
Devils Lake, North Dakota (C)	1138	1306	1179	1838	2075	2161	9970
Dodge City, Kansas (A)	761	826	672	1048	958	948	5035
Dubuque, Iowa (C)	735	981	846	1215	1264	1291	6790
Duluth, Minnesota (C)	973	1223	1074	1632	1954	1970	9483
Eastport, Maine (C)	671	797	843	1473	1396	1662	8520**
Elkins, West Virginia (A)	603	768	741	1244	1161	1182	5697
El Paso, Texas (A)	512	473	381	616	505	421	2428
Ely, Nevada (A)	1036	1081	(a)	1911	1819	(a)	(a)
Erie, Pennsylvania (C)	487	748	711	977	1020	1125	6273
Escanaba, Michigan (C)	802	997	960	1478	1547	1794	8771
Evansville, Indiana (A)	526	694	528	866	861	683	4244
Fort Smith, Arkansas (A)	444	519	408	614	553	470	3147
Fort Wayne, Indiana (A)	624	874	726	1166	1190	1073	5925
Fort Worth, Texas (A)	301	400	252	361	409	252	2148
Fresno, California (A)	364	435	315	466	500	334	2334
Galveston, Texas (C)	112	121	60	128	121	60	1016
Grand Junction, Colorado (A)	973	915	747	1328	1229	1116	5548
Grand Rapids, Michigan (C)	625	846	774	1123	1174	1250	6535
Green Bay, Wisconsin (C)	755	1023	921	1407	1459	1558	7825
Greensboro, North Carolina (A)	379	588	492	709	754	635	3529
Greenville, South Carolina (A)	321	491	450	531	587	596	3380
Harrisburg, Pennsylvania (A)	504	703	660	957	967	989	5375
Hartford, Connecticut (A)	547	759	705	1051	1155	1097	6036
Hatteras, North Carolina (C)	89	251	234	210	273	234	2571
Havre, Montana (C)	915	1129	1041	1639	1838	1931	8700
Helena, Montana (A)	939	1117	948	1840	1905	1813	7894**
Houston, Texas (C)	152	182	114	175	182	114	1157
Huron, South Dakota (A)	949	1179	1005	1532	1666	1654	8004
Indianapolis, Indiana (A)	610	772	687	1089	970	958	5298
Jackson, Mississippi (A)	249	339	(a)	343	347	(a)	(a)
Kansas City, Missouri (A)	563	749	639	814	866	858	4956
Knoxville, Tennessee (A)	395	513	519	656	592	702	3670
La Crosse, Wisconsin (A)	....	1082	909	....	1502	1467	7322
Lander, Wyoming (A)	1086	1153	726	1791	1831	1656	7947

(a) Data not available.

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

Figures in this table, with seven exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y., and Norman E. Ross, Bursar, Bates College, Lewiston Me., respectively; Anaconda, Bozeman, Butte, Deer Lodge and Livingston, Mont., through the courtesy of the Montana Power Company.

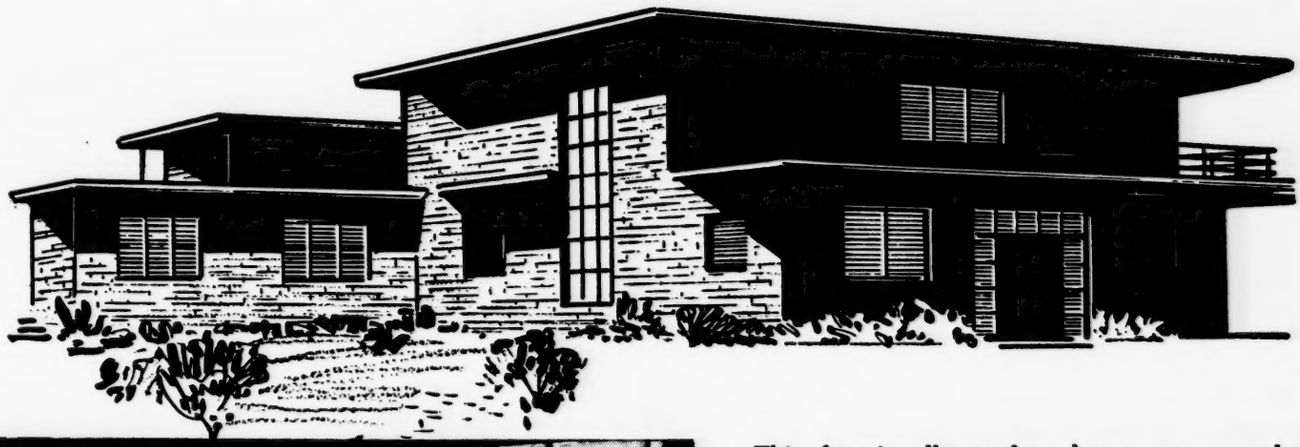
[Table concluded on page 118]

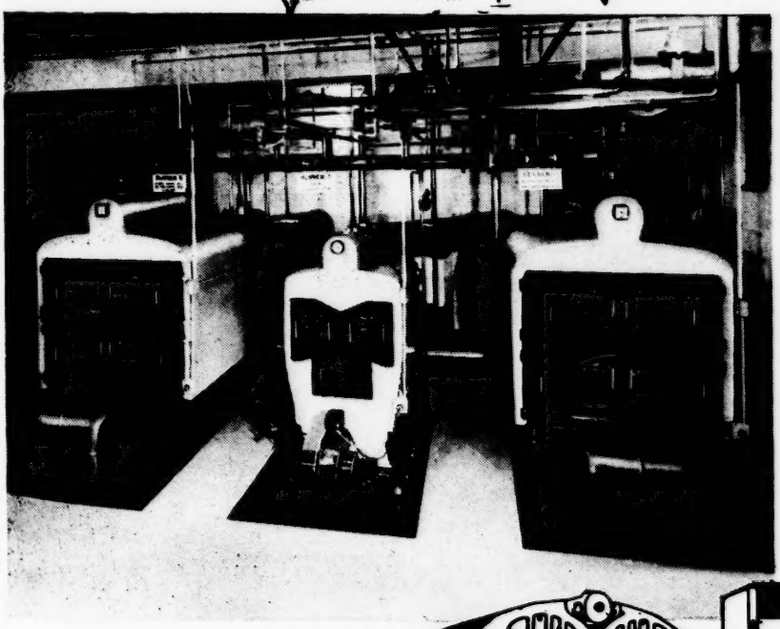
What boiler would you recommend for a $350,000 home?

The finest, of course. That's what the architect, engineer, and contractor did when they built this magnificent home. In fact, they chose *six* H. B. Smith boilers — two to heat the main house, by radiant heat and by air conditioning . . . one to supply domestic hot water . . . two to warm the swimming pool water and recirculate it . . . still another to supply domestic hot water and car-washing water to the garage.

No matter the size of the home your client wishes, you can recommend an H. B. Smith boiler that will give him "luxury" heating at bargain basement prices—for Smith-Mills boilers are designed and engineered to deliver maximum heat at lowest cost. True, they cost a little more to buy, but smaller fuel and maintenance bills more than make up the difference.

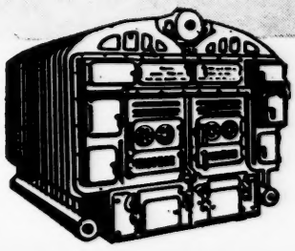
Which boiler will you specify on the next job where the best in residential, industrial, institutional or commercial heating is requested? You can't go wrong if you recommend H. B. Smith!

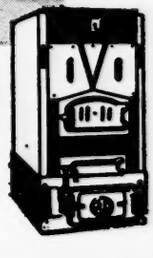




This functionally modern home was recently built in Bloomsburg, Pa., by Harry L. Magee, president of The Magee Carpet Company; it is one of Pennsylvania's finest show places. Berninger, Haag, and D'Entremont, Architects; George A. Heath, Heating Engineer; Wm. L. Coombs, Heating Contractor; Percy Swank, Building Contractor.

Largest boiler room in the Magee residence (there are several others!) includes two No. 340 oil-fired boilers and one No. 24 Hy-Test oil-fired hot water supply unit, all H. B. Smith products.





H. B. Smith

CAST-IRON BOILERS

THE H. B. SMITH CO., INC., 63 Main Street, Westfield, Mass. • OFFICES AND REPRESENTATIVES IN PRINCIPAL CITIES

Degree-Days for November, 1948 (Concluded)

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city.

HEATING AND VENTILATING'S 22nd Year of Publication of Monthly Degree-Day Data

City	November			Cumulative, Sept. 1 to Nov. 30			Heating Season[1]
	1948	1947	Normal	1948	1947	Normal	Normal
Lansing, Michigan (A)	633	910	861	1251	1347	1456	7048
Lewiston, Maine (O)	657	863	876	1297	1405	1542	7707
Lincoln, Nebraska (C)	756	870	753	1131	1096	1069	5999
Little Rock, Arkansas (A)	387	506	381	538	534	428	2811
Livingston, Montana (C)	948	1052	864	1576	1743	1614	7245**
Los Angeles, California (C)	101	182	123	143	197	123	1504
Louisville, Kentucky (A)	480	633	552	813	765	738	4180
Lynchburg, Virginia (A)	428	628	537	794	857	757	3980
Macon, Georgia (C)	226	390	324	372	425	330	2201
Madison, Wisconsin (C)	765	1036	891	1285	1417	1437	7429
Marquette, Michigan (C)	832	1041	960	1517	1607	1752	8693*
Memphis, Tennessee (A)	379	493	402	569	528	464	2950
Meridian, Mississippi (C)	261	354	312	382	367	334	2160
Milwaukee, Wisconsin (A)	704	938	846	1237	1310	1380	7245
Minneapolis, Minnesota (A)	897	1152	963	1383	1565	1537	7850
Montgomery, Alabama (C)	207	322	273	284	326	273	1884
Nantucket, Massachusetts (A)	483	677	609	970	1070	1007	5957
Nashville, Tennessee (A)	425	530	483	671	605	619	3507
New Haven, Connecticut (A)	513	701	693	933	1087	1092	5895
New Orleans, Louisiana (C)	102	140	102	223	190	102	1024
New York, New York (C)	380	631	594	689	841	916	5274***
Nome, Alaska (A)	1219	1216	1126	2046	1993	1870	14580**
Norfolk, Virginia (C)	227	407	411	402	475	510	3350
North Head, Washington (C)	599	518	510	1193	1088	1131	5452**
North Platte, Nebraska (C)	861	933	837	1326	1246	1313	6366
Oakland, California (A)	349	404	330	616	618	603	3143**
Oklahoma City, Oklahoma (C)	490	554	459	610	592	564	3613
Omaha, Nebraska (A)	752	886	780	1130	1134	1109	6131
Oswego, New York (C)	536	797	783	1146	1183	1356	7088
Parkersburg, W. Virginia (C)	474	661	624	914	861	909	4775
Peoria, Illinois (A)	664	895	789	1101	1123	1173	6109
Philadelphia, Pennsylvania (C)	376	598	544	665	783	815	4737***
Phoenix, Arizona (C)	242	262	156	256	266	156	1405
Pittsburgh, Pennsylvania (C)	462	773	669	920	1030	982	5235
Pocatello, Idaho (A)	935	975	813	1618	1568	1468	6655
Portland, Maine (A)	676	777	807	1362	1245	1446	7218
Portland, Oregon (C)	593	498	558	1021	840	995	4469
Providence, Rhode Island (C)	458	703	693	877	1001	1104	6015
Pueblo, Colorado (A)	831	917	741	1264	1251	1135	5514
Raleigh, North Carolina (C)	264	496	429	487	609	559	3234
Rapid City, South Dakota (A)	926	1103	870	1450	1583	1529	7118
Reading, Pennsylvania (C)	439	664	669	819	904	1013	5389
Red Bluff, California (A)	358	390	(a)	443	519	(a)	(a)
Reno, Nevada (A)	806	884	714	1407	1435	1311	5892
Richmond, Virginia (C)	326	544	456	594	700	617	3695
Rochester, New York (A)	564	829	786	1172	1204	1289	6732
Roseburg, Oregon (C)	600	512	561	1048	850	1022	4428
Roswell, New Mexico (A)	616	632	516	855	726	702	3484
Sacramento, California (C)	347	419	351	464	539	422	2653
St. Joseph, Missouri (A)	633	811	633	967	980	881	5161
St. Louis, Missouri (C)	499	702	597	758	835	802	4585
Salt Lake City, Utah (A)	891	890	723	1357	1278	1129	5555
San Antonio, Texas (A)	241	253	126	273	253	126	1202
San Diego, California (A)	152	198	165	208	204	199	1645
Sandusky, Ohio (C)	545	796	726	1026	1043	1079	6208
San Francisco, California (C)	256	291	261	568	537	521	3264**
Sault Ste. Marie, Michigan (A)	827	1034	978	1642	1699	1877	9285**
Savannah, Georgia (A)	88	231	201	166	243	201	1490
Scranton, Pennsylvania (C)	520	784	732	1053	1139	1189	6129
Seattle, Washington (C)	602	572	570	1172	1027	1150	4934**
Sheridan, Wyoming (A)	980	1121	978	1607	1711	1878	8008
Shreveport, Louisiana (A)	301	363	270	372	367	270	1938
Sioux City, Iowa (A)	871	973	870	1340	1330	1318	6898
Spokane, Washington (A)	909	907	819	1696	1549	1526	6355
Springfield, Illinois (C)	576	778	681	893	943	963	5373
Springfield, Missouri (A)	567	696	564	871	803	781	4428
Syracuse, New York (A)	551	835	798	1186	1264	1319	6893
Tacoma, Washington (C)	638	613	588	1302	1141	1195	5181**
Terre Haute, Indiana (A)	590	802	615	1026	1024	848	4872
Toledo, Ohio (A)	605	850	732	1177	1175	1110	6077
Topeka, Kansas (C)	589	755	639	841	875	875	4969
Trenton, New Jersey (C)	417	654	588	786	908	830	4933
Utica, New York (O)	519	860	781	1050	1263	1393	6796
Valentine, Nebraska (C)	909	1114	897	1467	1520	1480	7039
Walla Walla, Washington (C)	627	670	651	1159	1027	1013	4808
Washington, D. C. (C)	389	588	594	699	748	845	4626
Wichita, Kansas (A)	630	703	636	834	787	828	4673
Williston, North Dakota (C)	1008	1229	1137	1699	1990	2067	9323
Winnemucca, Nevada (C)	889	955	810	1496	1513	1509	6427**
Yakima, Washington (A)	809	739	780	1482	1287	1337	5599

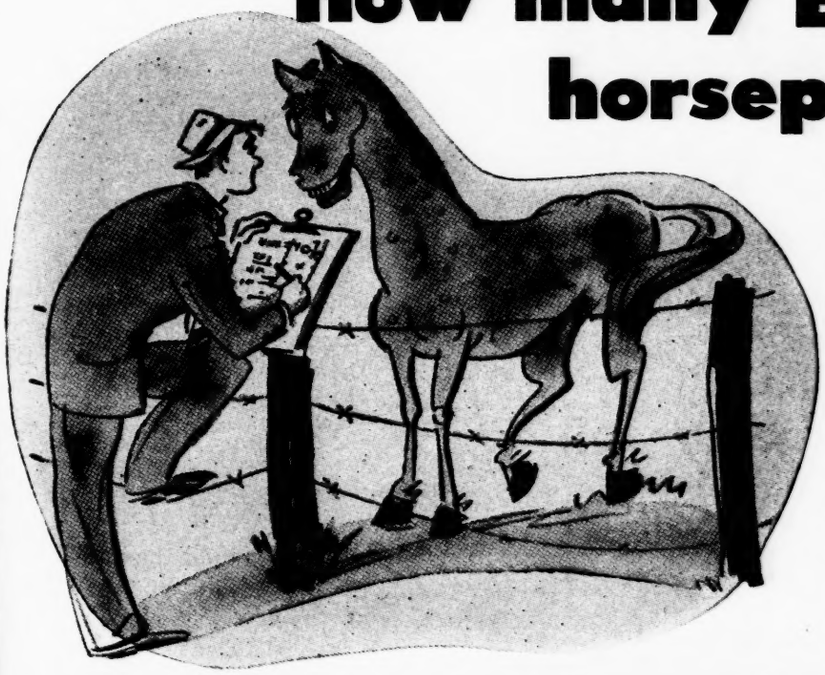
(a) Data not available.
†Nome data are for October.

*Includes August.
**Includes July and August.
***New 48-year normal covering 1898 to 1946.

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

BRUNNER SINCE 1906 REFRIGERATION helps you serve better

How many BTU's per horsepower hour?

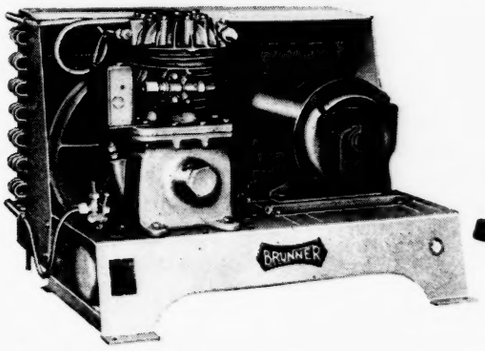


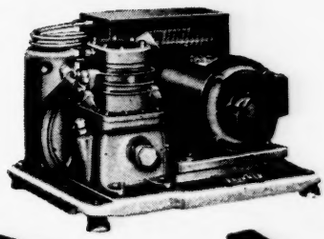
Refrigerating equipment installation engineers know that the refrigerating capacity of a condensing unit is measured in terms of BTU's produced per hour per horsepower. How many BTU's in a horsepower hour depends entirely upon compressor design and operating efficiency. Cost of BTU production is the whole cost of refrigeration.

Obviously, if a required refrigeration capacity can be produced with *less* horsepower, *less* running time, *less* wear in the unit, you can see where worthwhile installation economies can be effected plus a greater customer satisfaction.

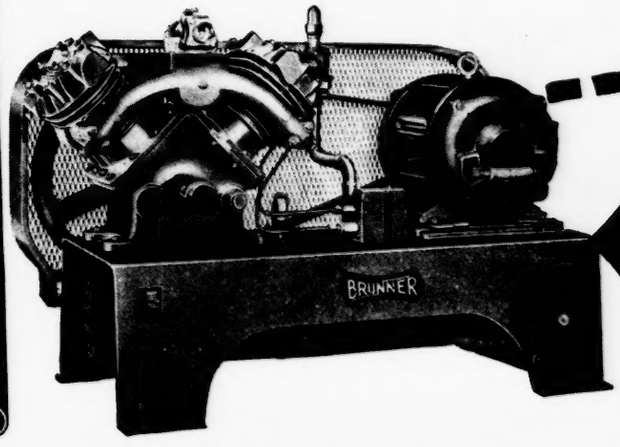
BRUNNER MANUFACTURING CO.
UTICA 1, NEW YORK, U. S. A.

● **IN YOUR BUSINESS** it's well to know all the answers. It will be time well spent to let a Brunner factory representative show you the many reasons why Brunner compressors deliver such a high and dependable efficiency. Just send your name and address.





REFRIGERATION CONDENSING UNITS
...a size and type for every purpose



BRUNNER SINCE 1906

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Abstracts and Reviews

Publications abstracted in this department should be ordered direct from publisher.

MATHEMATICS AT WORK

Mathematics at Work, by Holbrook L. Horton, Associate Editor of MACHINERY, is a working manual and guide for designers, engineers, mechanics, technical or trade school students, and teachers who solve mechanical problems. The practical applications of arithmetic, algebra, geometry, trigonometry, and logarithms are illustrated by a wide variety of problems taken from actual practice. While these problems have been taken largely from the field of mechanical design and manufacture, the basic mathematical procedures employed are applicable to all fields where mechanical problems are encountered.

Each problem is presented in such a way to show (1) what the problem is about; (2) how to analyze it and develop a method of attack and solution; (3) what formula is required, if a formula is directly applicable; (4) how this formula is derived, or if no formula is used the step-by-step procedure for solving the problem; and (5) how a typical example is worked out. This systematic presentation is designed to provide, as far as possible, the equivalent of personal instruction, making it easy to understand and follow the entire analysis and solution of each problem.

The classification of problems is mathematical; that is, problems illustrating some common mathematical principle or method have been grouped together. This classification makes it easy to find the general type of problem at hand or one closely paralleling it, hence it is possible to apply the manual to a much broader range of problems than might be at first apparent.

A reference section consisting of five chapters provides a concise but clear review of the practical fundamentals of arithmetic, algebra, geometry, trigonometry, and logarithms, so that where basic principles or formulas are used in the problem solutions they can be immediately referred to if necessary.

Methods of solution that are a frequent source of difficulty have been explained in detail. The reason for using approximate formulas and the way in which they are applied is one example. The step-by-step procedure in applying trial-and-error solutions is another. The use of empirical or "working" formulas is also discussed, and a variety of problems are presented to show how such formulas are applied. A chapter on refresher questions in methematics, mechanics, and strength of materials is included to clarify troublesome points frequently encountered in the solution of mechanical problems.

To round out the book as a complete working manual, 145 pages of standard mathematical tables, including logarithmic and trigonometric tables, are included.

Taken together, the review of mathematical fundamentals, the comprehensive discussion of problems and their solutions, the explanation of special aids in computation, and the many tables of useful data make this manual an indispensable working tool for all who are engaged in the mathematical solution of mechanical problems.

Mathematics at Work, by Holbrook L. Horton. Cloth bound, 6 x 9 in., 728 pages, 196 drawings and diagrams. Published by The Industrial Press, 148 Lafayette St., New York 13, N. Y. Price, $6.

REFRIGERATION AND AIR CONDITIONING

Refrigeration and Air Conditioning, by Dr. Richard C. Jordan, Professor of Mechanical Engineering at the University of Minnesota, and Gayle B. Priester, air conditioning engineer for the Consolidated Gas, Electric Light & Power Co., Baltimore, Md., is divided into separate sections to cover theory, application and equipment.

Various chapters review the history and potentialities of the refrigeration field and discuss the latest applications of air conditioning and the heat pump, as well as industrial applications. One chapter is devoted to an introduction of the basic refrigeration cycles and systems through a series of sequence drawings.

Problems, answers, line-drawings and other illustrations accompany the text. Various charts of the refrigerants: Ammonia, Freon-11, Freon-12, Freon-22, and carbon dioxide are contained in a pocket in the back of the book. The appendix includes tables of the properties of the common refrigerants as well as auxiliary data.

The book is intended for a comprehensive course in refrigeration and air conditioning, and to provide a reference book for the practicing engineer. The theoretical portions of the text assumes that the reader has a good grounding in physics and mathematics. Several chapters are devoted primarily to refrigeration applications, and no extensive theoretical background is required.

Refrigeration and Air Conditioning, by R. C. Jordan and G. B. Priester. Cloth bound, 6 x 9 in., 512 pages. Published by Prentice-Hall, Inc., 70 Fifth Ave., New York 11, N. Y. Price, $7.75.

BEACON BOILER REFERENCE BOOK

This book, which was sold out during the war years, has now been revised to embrace all models brought out since 1940. It covers obsolete boilers made in the United States, as well as recent makes.

It presents ratings and major specifications of domestic heating boilers up to 2,000 sq ft and it contains more than 10,000 boiler references under about 500 trade names of more than 250 manufacturers. Ratings were taken from the manufacturers' own

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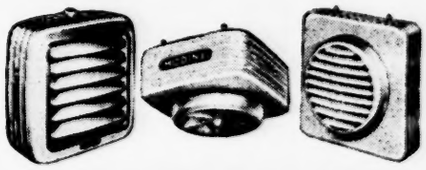

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statements of specifications and technical information. Wherever the manufacturers have used the code ratings of the Institute of Boiler and Radiator Manufacturers or of the Steel Boiler Institute, these ratings also appear in the compilations.

Beacon Boiler Reference Book. Bound in cardboard covers, 8 x 11 in., 200 pages. Published by Heating Publishers, Inc., 232 Madison Ave., New York 16, N. Y. Price, $3.

GAS TABLES

The properties of air have been re-examined and recalculated by the authors so that their previous book on Thermodynamic Properties of Air has been superseded by the present volume of Gas Tables. All values of thermodynamic properties are based on the examination of data from spectroscopic sources which were published in 1945 by F. D. Rossini and his coworkers of the National Bureau of Standards.

Properties of combustion products of hydrocarbons and other constituent gases have been added.

This work includes a chapter on the general development of the gas tables, and another which includes examples on the use of the tables. Included are 64 tables such as the properties of air and other gases at low pressure, conversion factors, one-dimensional normal-shock functions, and Raleigh Line for various values of k, and properties of standard atmosphere.

Joseph H. Keenan is Professor of Mechanical Engineering, and Joseph Kaye is Assistant Professor of Mechanical Engineering at Massachusetts Institute of Technology.

Gas Tables, by Joseph H. Keenan and Joseph Kaye. Cloth bound, 7 x 10 in., 238 pages. Published by John Wiley & Sons, Inc., 440 4th Ave., New York 16, N. Y. Price, $5.

BASIC REFRIGERATION AND AIR CONDITIONING

Although a number of books are available covering refrigeration and air conditioning, such texts were prepared for the student of college grade or for the engineer. This book by Robert H. Emerick, consulting mechanical engineer, is an outgrowth of time spent at the Pearl Harbor Navy Yard during World War II, when he had to train green personnel in the basic principles of refrigeration and air conditioning. These men were pipefitters, machinists and members of other trades.

Therefore, it was necessary for the author to explain theories and principles in such a manner that they would be understandable, regardless of the extent of the student's formal education. Complicated mathematics and formulas have been avoided. Mr. Emerick's book is recommended for students who wish to obtain a better understanding of refrigeration and air conditioning even though they are not acquainted with thermodynamics and psychrometry.

Some of the subjects covered are refrigerants and how they act; refrigeration by direct expansion; refrigeration by ammonia and brine; the steam-jet system; spray ponds and cooling towers; cold storage; making ice; air conditioning; calculating a job; fans and ducts; cabinet coolers; the heat pump; trouble shooter's chart. At the end of each chapter are a number of review questions.

Basic Refrigeration and Air Conditioning, by R. H. Emerick. Cloth bound, 6 x 9 in., 259 pages. Published by Prentice-Hall, Inc., 70 Fifth Ave., New York 11, N. Y. Price, $5.

INDUSTRIAL HYGIENE AND TOXICOLOGY

With the basic objective of presenting information that will safeguard the health and welfare of working people and in improving the working environment, Frank A. Patty, Director, Industrial Hygiene Service, General Motors Corp., has assembled a group of specialists to make available information on the broad field of industrial hygiene.

This comprehensive work has been divided into two volumes, and it is Volume I that is being reviewed. Volume II covers the various chemicals and compounds that may be contributory causes of illness in industry, and factors in environment.

Besides serving as editor, Mr. Patty contributed chapters on Industrial Hygiene—Retrospect and Prospect; The Industrial Hygiene Survey and Personnel; The Mode of Entry and Action of Toxic Materials; Sampling and Analysis of Atmospheric Contaminants; Respirators and Respiratory Protective Devices. The balance of the fifteen chapters were prepared by specialists in their respective fields. These chapters and the authors follow:

Industrial Hygiene Records and Reports, by John B. Littlefield, Assistant Technical Director, Chemical Department, American Brake Shoe Co., Mahwah, N. J.

Personnel Factors in Competence and Fatigue, by Joseph Brozek, Assistant Professor, Laboratory of Physiological Hygiene, University of Minnesota, Minneapolis, Minn.

Environmental Factors in Fatigue and Competence, by W. N. Witheridge, Ventilation Consultant, Industrial Hygiene Service, General Motors Corp., Detroit, Mich.

Physiological Effects of Abnormal Atmospheric Pressure, by Heinz Specht, Physiologist, Laboratory of Physical Biology, National Institute of Health, Bethesda, Md.

Radiant Energy and Radium, by Leon F. Curtiss, Radioactivity Section, U. S. Bureau of Standards, Washington, D. C.

Ventilation, by W. N. Witheridge.

Occupational Dermatoses, by Louis Schwartz, formerly Chief, Dermatology Section, Division of Industrial Hygiene, U. S. Public Health Service, Washington, D. C.

The Visible Marks of Occupation and Occupational Diseases, by Carey P. McCord, Medical Director, The Industrial Health Conservancy Laboratories, Detroit, Mich.

Fire and Explosion Hazards of Combustible Gas and Vapors, by G. W. Jones, Supervising Chemist, Gaseous Explosions Section, U. S. Bureau of Mines, Pittsburgh, Pa.

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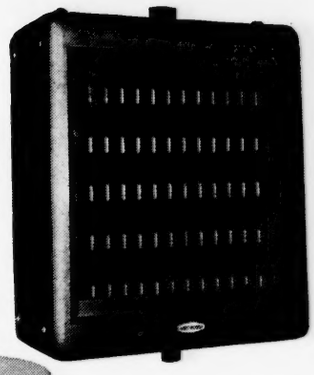

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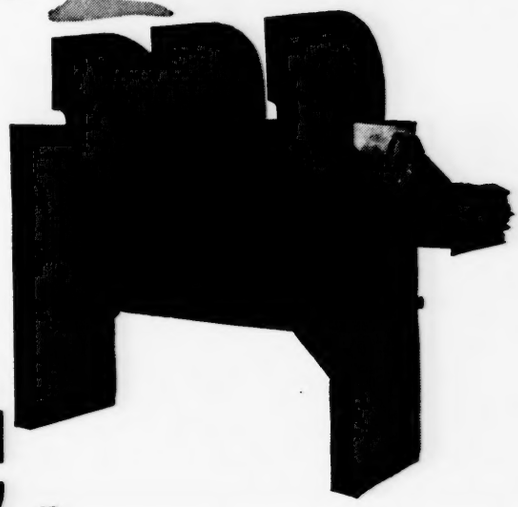

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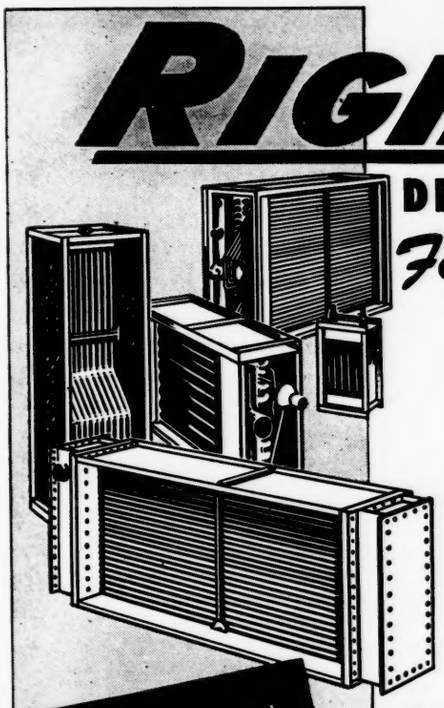

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Explosion and Fire Hazards of Combustible Dusts, by Irving Hartmann, Supervising Physicist, Experimental Coal Mine and Dust Explosions Research Section, U. S. Bureau of Mines, Pittsburgh, Pa.

Dust and its Role in the Causation of Occupational Disease, by Edward E. Dart, Medical Director, Pacific Industrial Hygiene Laboratories, Oakland, Calif.

Industrial Hygiene and Toxicology, Vol. I, edited by Frank A. Patty, Cloth bound, 6½ x 9¾ in., 531 pages. Published by Interscience Publishers, Inc., 215 Fourth Ave., New York 3, N. Y. Price, $10.

• • •

TENATIVE STANDARDS ON PIPE FRICTION—Available in convenient tables, the Hydraulic Institute has issued a set of tables showing friction loss for water in pipe sizes from ⅛ in. to 84 in. For the smaller pipe sizes, the tables are based on wrought iron or steel schedule 40 pipe, and for the larger sizes, there are separate tables for each stadard size for steel and asphalt dipped cast iron pipe. In each table, the flow is shown in gpm and cfs with the corresponding velocity, velocity head, and the friction loss per 100 ft of pipe. A series of charts is presented for computing the friction loss for liquids other than water, showing the complete range of viscous and turbulent flow in pipe diameters from ½ to 12 in. Beside these data, there is a listing of the losses in valves and fittings. This information was assembled from a number of sources and represents the latest and most complete compilation. To supplement the use of the tables and charts, the book contains tables on the viscosity and specific gravity of a wide range of commercial liquids and gases, and dimensions of standard steel, wrought iron and cast iron pipe. Price, $1.50, Hydraulic Institute, 90 West St., New York 6, N. Y.

WARM AIR HEATING—Two of the series of manuals published by the National Warm Air Heating and Air Conditioning Association on various phases of warm air heating have now appeared in the second edition. These are Manual 3 and Manual 7, entitled respectively "Measuring Heat Losses" and "Code and Manual for the Design and Installation of Warm Air Winter Air Conditioning Systems." Manual 3, 44 pages, is a comprehensive instruction booklet on the title subject and includes heat loss coefficients for all types of walls, floors, roofs and windows. Manual 7, 24 pages, which covers structures having design heat losses not over 120,000 Btu per hour gives information regarding selection of equipment sizes, location of registers and grilles, procedure for determining duct and register combinations, and data on duct sizing. The manuals sell for 60 cents each. National Warm Air Heating and Air Conditioning Assn., 145 Public Sq., Cleveland 14, Ohio.

STATISTICAL INFORMATION—Thirty-one tabulations relating to the production, labor, distribution and related factors concerning the economics of the Pennsylvania anthracite industry. This is the fourth edition of this booklet. Anthracite Institute, Wilkes-Barre, Pa.

NEW CATALOGS

Glass Blocks

A 16-page booklet on the control of natural daylight through the use of functional glass block includes a nomograph for estimating illumination levels and technical data covering thermal characteristics, surface condensation, solar heat gain, etc.—*Pittsburgh Corning Corp., 632 Duquesne Way, Pittsburgh, Pa.*.....1

Fuel Saving Tips

Twenty simple tips for saving fuel in home heating are contained in an illustrated booklet using the theme, "Catch Ali Baba and his 20 Thieves," with humorous drawings. — *Minneapolis-Honeywell Regulator Co., Minneapolis 8, Minn.* 2

Steam Generators

Titusville steam generators are described in a 10-page bulletin, No. B-3250A. Engineering drawings of standard and specially designed boilers, performance rating charts, specification tables, and typical installation photographs are included.—*Titusville Iron Works, Titusville, Pa.* 3

Corrosion Resistant Concrete

Methods and materials used in placing corrosion and heat resistant concrete in various industrial applications are described in a booklet covering Lumnite concrete floors. Service experience, late developments, and typical uses of corrosion resistant concrete are described. — *Lumnite Division of Universal Atlas Co., 135 E. 42nd St., New York 17, N. Y.* 4

Cooling Towers

Worthington Series CTZ, 3- and 5-ton cooling towers are described in a specifications data sheet showing capacities and typical performance. Sheet is punched for looseleaf binding.—*The Worthington Pump and Machinery Corp., Air Conditioning and Refrigeration Division, Harrison, New Jersey* 5

Refrigeration Engineering Data

Kramer engineering data on refrigeration load calculations, wall heat losses, food storage problems, and beer container design are included in a 14-page manual, catalog R-114. Useful supplementary data are appended.—*Kramer-Trenton Co., Trenton 5, N. J.*....6

Glass Data Sheet Handbook

The Pittsburgh Data Sheet Handbook covering products of Pittsburgh Plate Glass and Pittsburgh Corning is a tab-indexed book of data sheets covering grades, selection, utilization, heat transfer, and other properties of various glass products including plate glass, Twindow, Carrara, and architectural glass, with a supplementary section on paint.—*Pittsburgh Plate Glass Co., 632 Duquesne Way, Pittsburgh 22, Pa.*.....7

BINKS } Steel-cased Induced Draft Cooling Towers

A size and type for every water-cooling requirement.

Binks Type 2K-S spray filled induced draft cooling towers. Binks 2K-S series cooling towers are ideal for a wide range of commercial water-cooling applications within 150-645 GPM capacity, where use of nozzles is preferred to interior decking for water distribution and break-up. Simple in construction, these units are easy to assemble and erect in the field without skilled help or factory supervision. In 20 standard sizes.

Binks Type 2K-W wood filled steel cased induced draft cooling towers. Series 2K-W cooling towers are widely used for all sorts of industrial applications where high wet bulb design conditions must be satisfied. These towers are all-steel construction, with internal decking and drift eliminators of redwood. Filming action of deck surfaces increases length of time that water is exposed to air, thus creating greater cooling efficiency. Available in 20 standard sizes.

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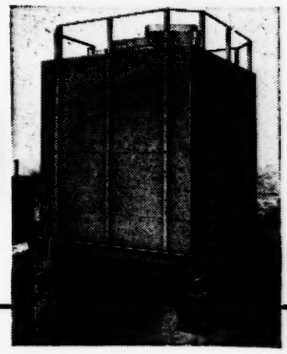

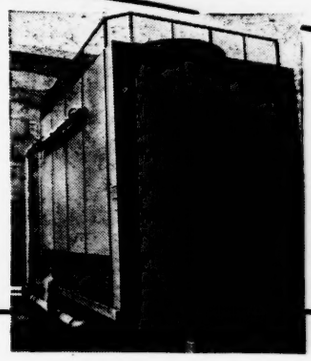

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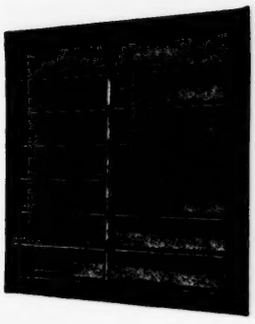

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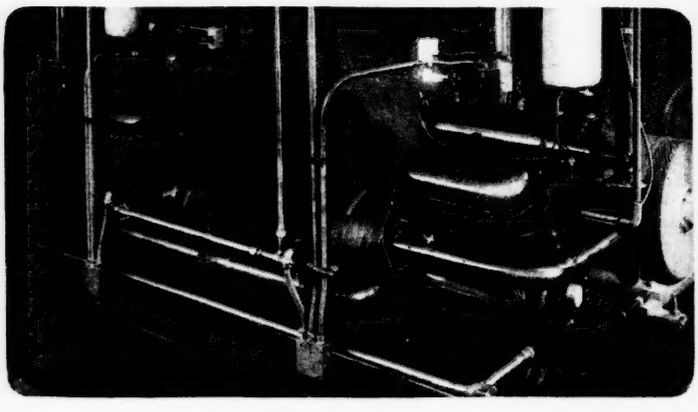

Air Conditioning Units

Worthington Series AHY and AVY air conditioning units for commercial and industrial applications are described in Bulletin C-1100-B33, including specifications, capacities, and physical data.—*Worthington Pump and Machinery Corp., Air Conditioning and Refrigeration Div., Harrison, N. J.* 8

Pipe and Fittings

Karbate brand pipe and fittings featuring corrosion resistance, thermal shock resistance, heat transfer and other qualities are described in catalog section M-8800B. Parts are made of impervious carbon and graphite materials, impregnated with chemically resistant synthetic resins to make them impervious to fluids under pressure. Two types of resin impregnants are employed to accommodate different service requirements. Catalog features chemical resistance tables and data covering density, velocity, strength and other characteristics.—*National Carbon Co., Inc., 30 East 42nd St., New York 17, N. Y.* 9

Pan-L Grid Design Manual

A 40-page manual on the design and applications of Pan-L Grid prefabricated pipe coils for radiant heating including dimensions, rating, performance curves, and pump sizing tables. Typical installations are illustrated.—*Pan-L Heat Corp., 2831 N.E. Columbia Blvd., Portland 11, Ore.* 10

Single-Bearing Motors

A 4-page folder describes Redmond single-bearing shaded-pole a-c motors newly introduced under the trade name Monomotors. Photographs and cutaway drawings illustrate construction details. Dimension charts and performance rating tables are included.—*Redmond Company, Inc., Owosso, Mich.* 11

Water Tube Boilers

Titusville 3-drum water tube boilers are described in a 10-page technical bulletin which includes performance curves, specifications and selection charts. Typical setting diagrams for single and battery installations are included. Bulletin No. B-3200A.—*Titusville Iron Works Co., Div. of Struthers Wells Corp., Titusville, Pa.* 12

Dehumidifier Performance Bulletin

A new bulletin entitled "The Performance of a Solid Adsorption Dehumidifier," written by Lectrodryer consulting engineers, E. R. Queer and E. R. McLaughlin, both on the staff of the Engineering Experiment Station at Pennsylvania State College, deals with important recent developments in the use of solid adsorption for the control of humidity. Work with dehumidification equipment for the U. S. Navy is explained. A method of plotting dehumidification performance on a psychrometric chart is presented.—*Pittsburgh Lectrodryer Corp., P.O. Box 1766, Pittsburgh 30, Pa.*...13

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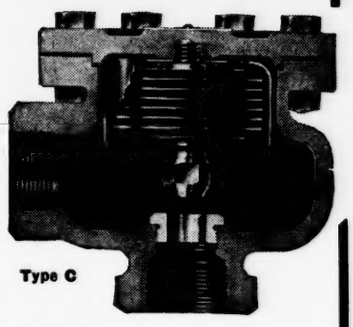
Larger, At-Bottom Valve Keeps Nicholson Traps Clean



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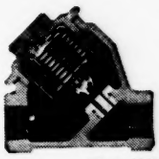

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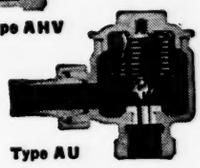

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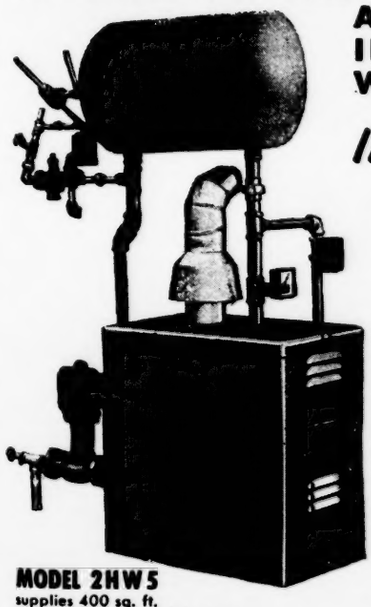

MODEL 2HW5
supplies 400 sq. ft. radiation and 3 gal./min. hot water. Floor space 18" x 27".

IDEAL For:

LOW COST HOUSING
GARDEN APARTMENTS
RADIANT HEATING
CONVECTOR HEATING

• • •

HYDROTHERM is of all cast iron construction—fully AGA approved for all gases—more than 10,000 units in operation.

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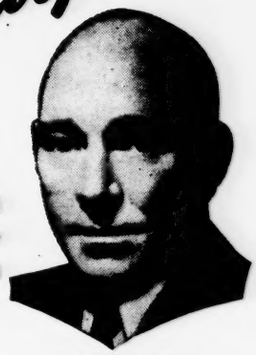
Don't overlook this important development

Write TODAY for ENG. BULLETIN # 1003

HOOK & ACKERMAN Inc.
18 East 41st St New York 17 N Y

FOR *Quality Products Prompt Service Profitable Cooperation*



Buy from a Herman Nelson Distributor like Hajoca Corporation of Philadelphia, Pa.

C. C. Lowry,
Vice President — General Sales
Hajoca Corporation
Headquarters at
Philadelphia, Pennsylvania

The friendly feeling that exists between The Herman Nelson Corporation and carefully selected Distributors, including Hajoca Corporation with its many branches, is based on a close working arrangement and service as well as products. Around the nation, wherever Herman Nelson Heating and Ventilating Products are sold, Dealers have discovered that the combination of quality products, prompt service and intelligent cooperation from Herman Nelson Distributors, results in increased business and satisfied customers.

Superiority of Herman Nelson Products can be traced to 42 years' experience. During that time, Herman Nelson engineers have developed a mastery of workmanship and design which has resulted in products with a new high standard for performance and durability. Thousands of satisfied customers best illustrate the fact that the Herman Nelson nameplate means unmatched excellence of product.

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Dealers all over America have commented favorably on the advertising and sales promotion material and comprehensive engineering data furnished by Herman Nelson. This sales and installation assistance will mean added profits to you as a dealer.

Yes, quality products, prompt service and intelligent cooperation — a trio of "profit-getters" — have built an enviable reputation for Herman Nelson, its Distributors and Dealers everywhere. They will do the same for you. Get the details from your nearest Herman Nelson Distributor today.

THE HERMAN NELSON CORPORATION
Since 1906 Manufacturers of Quality Heating and Ventilating Products
MOLINE, ILLINOIS

PROVED!

Kathabar HUMIDITY CONDITIONING FOR PROCESSING AND COMFORT

IN LEADING INDUSTRIES

A PARTIAL LIST OF KATHABAR APPLICATIONS

CHEMICAL
Photographic Film Processing and Storage
Match Drying • Stencil Drying
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Gelatin Capsule Processing
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Chemical Processing
Processing of Sodium
Vitamin Mfgr.
Gunpowder Processing
Processing Plastics
Rocket Powder Processing

MANUFACTURING
General • Ceramics Drying
Storage of Highly Finished Metal Parts (Corrosion Prevention)
Compressed Air Drying
Covered Cable Drying

METALS INDUSTRY
Powdered Metals Processing
Cupola Dry Blast (Foundry)
Safety Glass Manufacturing
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Candy Making • Fish Drying
Bean Sprout Cultivation
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Cranberry Dehydration
Milk Drying • Spaghetti Mfgr.

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Shoe Drying

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Rayon Storage
Nylon Hosiery Knitting

MISCELLANEOUS
Cargo Ship Dehumidification

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Paper Testing
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COMFORT AIR CONDITIONING
Auditoriums • Hospitals Rooms
Department Stores • Hotels
Restaurants • Cafeterias
Drafting Rooms
Office Buildings
Banks • Dental Laboratories

● In 1942, a leading midwestern pharmaceutical manufacturer installed the first Kathabar Humidity Control System in its plant. Since that time 19 additional units have been placed in operation in this plant on individual product production lines and five more units are on order to be installed. Some of these systems maintain atmospheres of less than 10 percent relative humidity at 80°F. Others at higher humidity conditions.

A pilot installation for humidity control in the plant of a leading match manufacturer proved Kathabar's superior operation over existing mechanical cooling methods by producing more consistent conditions, simplifying the operation, and reducing greatly the initial maintenance and operating costs. Their first permanent Kathabar installation was made in early 1947 and plans are now underway for complete replacement of the balance of obsolete equipment of previous methods.

These are *only two* examples where leading processing industries have benefited greatly by installing Kathabar Systems. Today there are over 300 installations in operation. Many of these units represent repeat orders. Why? Because *Kathabar Systems do control humidity—produce the desired results and reduce costs.*

GET THE FACTS • Ask a Kathabar Humidity Engineer to tell you about Humidity Conditioning. Let him present proof of Kathabar reliability and dependability. Get the facts first-hand!

RETURN THIS COUPON

☐ Send booklets on Industrial and Comfort Humidity Conditioning
☐ Have Kathabar Humidity Engineer call. No obligation

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ADDRESS.....
CITY.....STATE.....

SURFACE COMBUSTION CORPORATION • TOLEDO, OHIO

Norge History

The story of Norge, a short history of the founding and development of the firm, introduction of new products, and present activities, is contained in a 20-page booklet.—*Norge Division of Borg-Warner Corp., Detroit, Michigan.* 14

Unit Heaters

Catalog No. 348 covers factors in designing of unit heating systems and specification of equipment. Certified ratings, application views, dimensions and capacities are included. Examples of heat loss estimating and suggestions of location of units are illustrated with drawings and tables.—*Ilg Electric Ventilating Co., Chicago, Ill.* 15

Movable Walls

A 24-page brochure covers transite movable asbestos walls and partitions. Photographs illustrate recent installations. Construction drawings show how walls are erected.—*Johns-Manville, 22 E. 40th St., New York 16, N. Y.* 16

Steel Roofing

A 48-page catalog describes steel roofing products and presents data on grounding connections, materials, joints, roofing pitches, etc.—*Republic Steel Corp., Cleveland 1, Ohio.* 17

Product Coolers

Worthington Series UCY Freon-12 product coolers are covered by a specifications data sheet including directions, dimensions, fan data, tonnage range, etc. *Worthington Pump and Machinery Corp., Air Conditioning and Refrigeration Div., Harrison, N. J.*.....18

Steam Humidifiers

A 12-page bulletin, No. 1771, describes Armstrong steam humidifiers for automatically controlling relative humidity. Tables and charts are included on desirable relative humidity in various industries, regain of hygroscopic materials, water content of saturated air, etc.—*Armstrong Machine Works, Three Rivers, Mich.* 19

JANUARY, 1949

TO OBTAIN COPIES OF TRADE LITERATURE listed in this issue, circle on the list below the publication wanted, using item number at the end of each review. Print your name and address, mail to

Editor, HEATING AND VENTILATING, 148 Lafayette Street, New York 13, N. Y.

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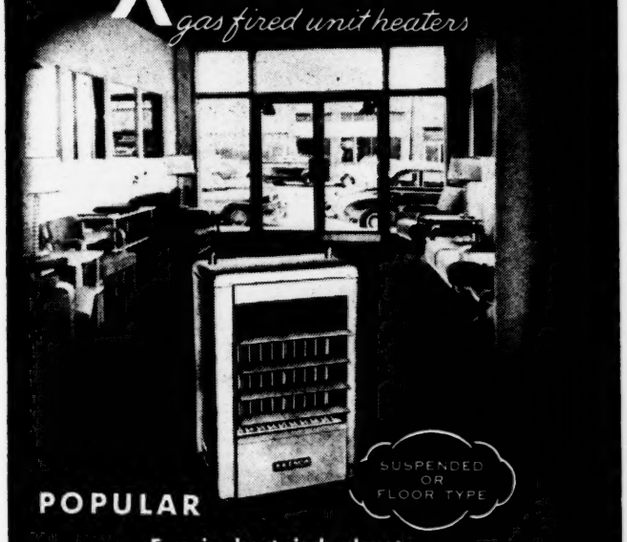
Automatic
REZNOR
gas fired unit heaters



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For industrial plants
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More sold than any other
Made since 1888
Catalog shows special features. Write today.

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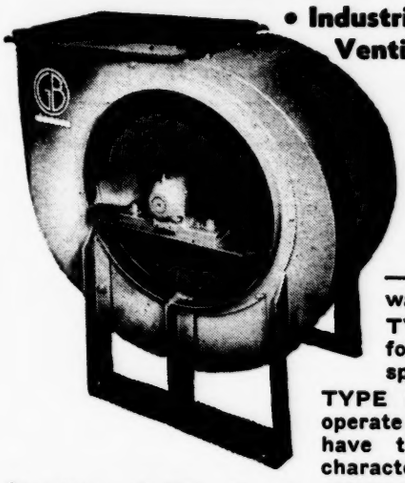
★ VENTILATING FANS

GB Fans—*manufactured for*



- **Industrial and Commercial Ventilating and Heating**
- **Fume Extraction**
- **Induced Draft**
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- **Air-conditioning**
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—are of forward or backward curved wheel design.

TYPE F. C. are designed for quiet operation at low speeds.

TYPE B. C. are designed to operate at high speeds and have the non-overloading characteristics.

Capacities of 200 c.f.m. to 300,000 c.f.m. are covered by standard sizes and arrangements.

The heavier constructions of classes II, III and IV cover the particular needs of special applications.

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GENERAL BLOWER CO.
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● Engineering Offices in All Principal Cities

Announcing

HENDRICK

Bulator

the first practicable combination of an ornamental grille and a deflecting vane grille.

Recently developed by Hendrick, and tested by Professor G. L. Tuve of the Case Institute of Technology, Cleveland, the Hendrick BULATOR* meets every requirement of architect and engineer for a grille of attractive appearance with proper air throw and spread.

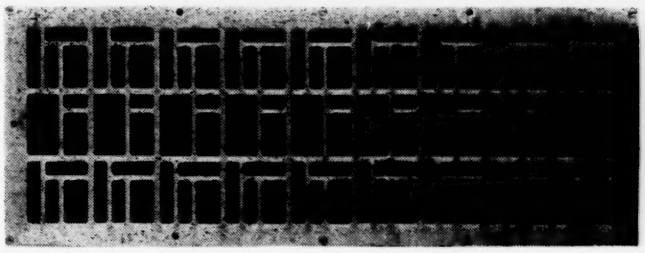
Mounted just behind the ornamental grille, the deflecting grille is not noticeable, but gives the air throw and spread that may be specified by the engineer. The tests made at the Case Institute showed that the presence of the ornamental grille made "very little difference on either the air stream pattern or the throw."

The vanes of the deflecting grille are adjustable so that the air flow can be deflected to right or left, up or down, or in a combination of directions.

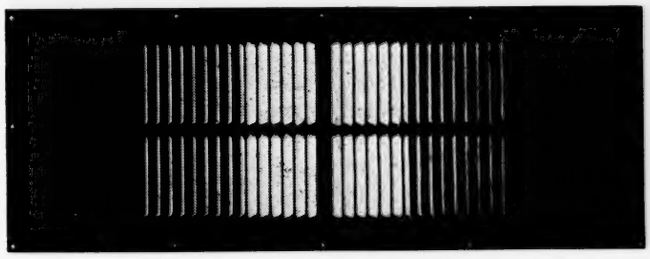
A wide variety of Hendrick ornamental grilles, with ample open area, are available, so that the BULATOR enables the architect to combine with the air-conditioning system of a building ornamental grilles which harmonize with the decorative scheme, without appreciably affecting the air throw.

*Beauty + Ventilator

Write for full information



Photograph taken with deflecting vanes less than a half inch behind grille, shows that vanes are not noticeable.



Vertical deflecting vanes, showing how the vanes may be set to produce any desired air stream pattern.

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Perforated Metal Screens
Architectural Grilles
Mitco Open Steel Flooring, "Shur-Site" Treads and Armorgrids

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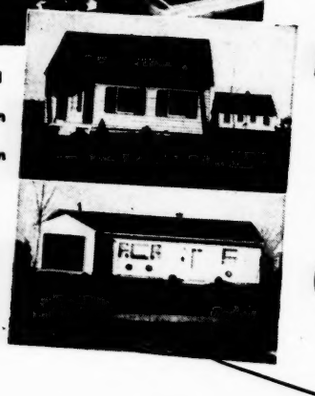


in
MORE THAN
300
WINDSOR
VILLAGE
(Indianapolis)
HOMES

RADIANT FLOOR PANELS
plus *Triplex* SPECIALTIES

Assure Hot Water
Heating at its BEST

In selecting the best type heat for more than 300 homes without basements, it was logical for the principals in charge of developing and building Windsor Village (Indianapolis) to agree on hot water with radiant floor panels. For assurance of unvarying winter comfort, it was just as logical for them to specify Triplex Specialties . . . economical, too, since standard Triplex Circulators (at no extra cost) could be used for fully effective hot water circulation in all the homes. Best of all, heating results and buyer satisfaction are meeting the highest expectations. Yes, *Triplex means hot water at its best* . . . in performance, popularity, and profits for you. Write today for latest catalog.

Direct Drive Circulators

Relief and Pressure Reducing Valves

Air Vent Valves

Indirect Heaters

Triplex
HEATING SPECIALTY CO., INC.
PERU, INDIANA

In addition to units illustrated, the Triplex line includes—Direct Drive Vertical Circulators, Indirect Drive Circulators, Flow Control Valves, One-Pipe Distributors, Expansion Tanks, Air Eliminators, Water Mixing Valves, Tankless Heaters, Control Units, Electrical Controls, Barometric Draft Dampers, Sump Pumps.

SEE YOUR WHOLESALER TODAY

WHAT READERS SAY

Outside Temperature Control

EDITOR, HEATING AND VENTILATING:

I enjoyed reading Mr. Robert Fitzgerald's comments on page 120 of your November issue, on Mr. Canar's article entitled "Does Oil and Gas Heating Demand Extra Radiator Surface?" which appeared on page 65 of your September issue.

It seems to me any advantages claimed by Canar for oversized heating installations would be more than offset by the discomforts of attendant over run in temperature. The slight advantages of faster warm up on a steam system would be more than offset by the overheating.

Even at design temperature, an ordinary steam or hot water job is "Oversized" by the usual allowances for pickup. Then, acceptance of Canar's additional allowance, pyramids the evils to the extent that at moderate outdoor temperatures the hunting would be terrific.

As Mr. Fitzgerald points out, better heating is obtained by better controls. Heating thermostats now incorporate some form of heat levelling or adjustable differential, and inexpensively help good heating performance.

Outdoor-indoor controls go a step further, and at a cost probably less than the oversizing suggested.

Regarding oversizing, I lean towards omitting pick-up allowance on many jobs to gain evener performance and longer running cycles on firing equipment.

Richard M. Stern
Consulting Engineer

Seattle, Wash

Canadian Degree-Days for November, 1948*

City	November 1948	November Normal	Cumulative, Sept. 1 to Nov. 30 1948	Cumulative, Sept. 1 to Nov. 30 Normal
Calgary, Alta.	1005	1122	2008	2276
Charlottetown, P.E.I.	744	858	1507	1619
Crescent Valley, B. C.	969	981	2012	2039
Edmonton, Alta.	1152	1215	2255	2406
Fort William, Ont.	1002	1143	1947	2219
Grande Prairie, Alta.	1257	1218	2453	2510
Halifax, N. S.	645	789	1310	1477
London, Ont.	690	843	1378	1477
Medicine Hat, Alta.	972	1104	1724	1972
Moncton, N. B.	783	936	1653	1813
Montreal, P. Q.	698	948	1379	1689
North Bay, Ont.	837	1017	1729	1975
Ottawa, Ont.	720	984	1456	1783
Penticton, B. C.	822	813	1679	1553
Porquis Junction, Ont.	978	1266	1955	2462
Prince George, B C.	1050	1068	2311	2253
Quebec City, P. Q.	777	1050	1531	1977
Regina, Sask.	1227	1355	2179	2557
St. John, N. B.	705	870	1475	1698
Saskatoon, Sask.	1266	1305	2189	2482
Toronto, Ont.	593	817	1176	1489
Vancouver, B. C.	705	657	1483	1350
Victoria, B. C.	636	462	1293	1172
Windsor, Ont.	609	795	1166	1274
Winnipeg, Man.	1173	1302	1868	2376

*These data are supplied through the courtesy of the Meteorological Division, Air Service Branch, Department of Transport, Canada.

The Department reports a slight revision in the figures for October as published in last month's issue. Corrected figures are: Charlottetown, P.E.I., 505; Montreal, P. Q., 549.

Take the Air Cleaning "Gamble" out of your installations with RP AIR FILTERS by RESEARCH

They're the result of exhaustive research and experiment in materials and filter media, developed *solely* for improving air cleaning efficiency. Because R-P Air Filters are planned and designed from "drawing board up," they offer you higher dust-holding capacity, lower air resistance, and scientific air flow.

Remember, your reputation rides on air borne particles of dust. Protect it, guarantee it with R-P Air Filters, already "performance-proved" on leading equipment.

Use ALL these R-P Products — to your benefit . . .

RP FIBER Self-Seal AIR FILTERS

"Self-sealing" edge fits snugly to prevent air by-pass. Special adhesive-treated, expanded fiber stops 99% of pollen, 93% of dust.

Series 200

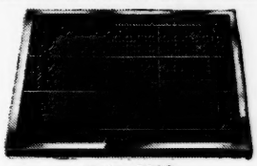
Series 900

RP ALŪMALOY INDUSTRIAL WASHABLE FILTERS

Expanded adhesive-coated "Alūmaloy" media in aluminum frame for years of service in commercial air conditioning. Easy to clean and recharge.

RP ALŪMALOY E Z Kleen AIR FILTERS

New, Lightweight, with expanded aluminum filter media for domestic heating and packaged air conditioning units. — Highly effective, easy to clean, and long-lasting.



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RP "SNAP-IN" GRIDS FOR FILTER BANKS

Time-saving, labor-saving wire grids with synthetic rubber tips — simplify Self-Seal filter pads replacement. No hooks or screws.

RP ALŪMALOY GREASE FILTERS

Trap 98% of dangerous grease particles. Pay for themselves in reducing fire hazards, improving sanitation, protecting equipment. All-metal construction. Series 930

RP CARDBOARD FRAME REPLACEMENT FILTERS

Special R-P adhesive coated fiber media in rugged frame. High dust-holding capacity.

Series 100

RP "FILTER WATCHMAN"

Takes guesswork out of filter replacement. Signal light indicates when filters are loaded.

RP COMPLETE AIR CLEANING PRODUCTS

also include: Roll Filter Media, Filter Banks, and R-P Filter Coat.

Get YOUR copy of R-P Techni-Data-Booklet . . . for helpful information on air filtration.

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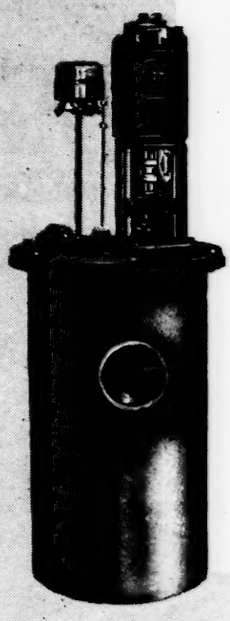
RP FILTERS . . . for FINER LIVING

Chosen as standard equipment by leading manufacturers

SKIDMORE tells the STORY

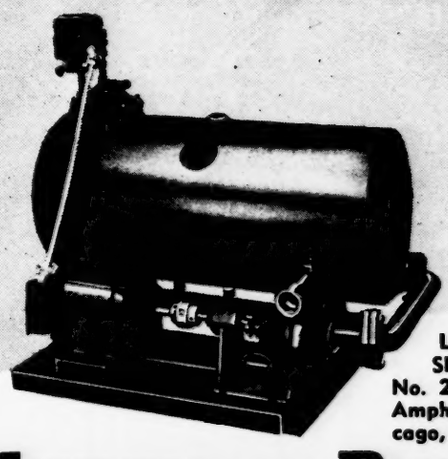
MANUFACTURERS OF QUALITY PUMPS FOR OVER A QUARTER OF A CENTURY



Specify a SKIDMORE Pump for your next job and be sure of real pump performance. Two popular SKIDMORE pumps illustrated: The UV Type pump is especially designed for use where returns are too low to permit the use of the horizontal type. The new economical model HS Condensate Pump and Receiver . . . a fine example of maximum efficiency and lower operating cost.

Each SKIDMORE Pump is built for a specific job, to assure efficient operation at a minimum cost and upkeep. This is the SKIDMORE Story:

"The Right Pump for Every Purpose."



LOOK! For the Skidmore booth No. 227-229 at the Amphitheatre, Chicago, January 24-28.

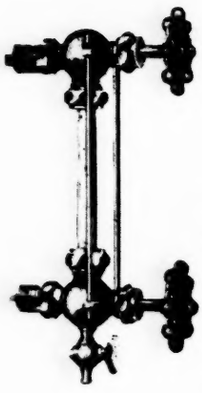
SKIDMORE Pumps

ST. JOSEPH, MICHIGAN

FOR BETTER WATER GAUGES

USE Roberts

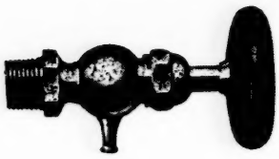
- **SOLID BRASS**
- **SELF-CLEANING**
- **FOR WORKING PRESSURES Up To 175 POUNDS**



For decades Roberts Water Gauges have been a standard of quality wherever tubular glass gauges are used.

Modern design—made of solid brass with plenty of strength. Self-cleaning feature keeps lower part of gauge from clogging with scale. Special packing allows free expansion of glass, avoiding breakage.

COMPRESSION GAUGE COCKS



Solid brass, durable, with seats that stand long use. Model shown has stuffing box.

Also offered in light pattern less stuffing box.

AIR COCKS—STEAM GAUGE COCKS

Roberts makes air cocks of all types and steam gauge cocks for pressure gauges.

All sizes – 1/8" up to 1/2".

Write for information on Roberts Gauges and Cocks.

THE ROBERTS BRASS MANUFACTURING CO.

Manufacturers of Brass Goods for Steam, Water, Gas and Air

5435 WEST FORT ST. • DETROIT 9, MICH.

INDUSTRIAL DEGREE-DAYS

November, 1948

City	55F Base	45F Base
Baltimore, Md.	118	9
Buffalo, N. Y.	260	62
Chicago, Ill.	318	93
Cleveland, Ohio	264	61
Detroit, Mich.	292	72
Indianapolis, Ind.	330	97
New York, N. Y.	123	12
Philadelphia, Pa.	124	15
Pittsburgh, Pa.	198	33
St. Louis, Mo.	226	67

Getting Personal

S. Fritz

Sigmund Fritz (*Solar Radiation During Cloudless Days*, page 69) was born in Brooklyn, New York, where he was confined, except for occasional excursions to Manhattan, until he received his B. S. degree in Mathematics from Brooklyn College in 1934. After about a year with the NACA at Langley Field, Virginia, he entered the U. S. Weather Bureau in 1937 and has served mainly in New York City and Washington, D. C. In 1941 he received his M.S. from M.I.T. in Meteorology and shortly thereafter (1942-1946) he donned the Navy blue as an aerologist engaged in chasing typhoons and Japanese from Tarawa to Tokyo on board two aircraft carriers, the U.S.S. Corregidor and then the U.S.S. Independence (of subsequent Bikini fame). After that martial interlude he returned to the Weather Bureau to engage in solar and terrestrial radiation research in the Meteorological Physics Section, Scientific Services Division. He is a professional member of the American Meteorological Society.

H. E. Smith

Howard E. Smith (*How to Evaluate Operating Characteristics of Suspended Unit Heaters*, page 75) began his experience in heating with a jobber in Springfield, Ill., where he was raised. He then became associated with the St. Louis representative of the Modine Manufacturing Company in the sale and application engineering of heating equipment. During the early part of World War II, he spent several years as field engineer in charge of important construction work for American Power Piping Corporation in St. Louis. After a short period in the Navy, he became connected with Modine as sales engineer, working in the company's home office in Racine on application engineering of unit heaters. At the close of 1948 he became associated with Schultz & James, Inc., in Richmond, Va., again in the selling and application engineering end of that firm's business, which is in heating and power plant work.

. . . Since the Last Issue

The appointment of **Robert A. Wilson** as Columbus, Ohio, representative of **Warren Webster & Co.**, pioneer heating equipment manufacturers, Camden, N. J., has been announced. Mr. Wilson succeeds the late M. R. Hamlin, heating and ventilating engineer, who died on Aug. 11 as the result of injuries received in an automobile accident.

The **Young Radiator Co.**, Racine, Wis., announces that the **National Requirements Service**, Dayton, Ohio, William W. Bentley, Jr., president, has been added to the list of the Young Radiator Co.'s representatives for specific representation at Wright-Patterson Air Force Base, Dayton, Ohio.

The **Whittington Pump and Engineering Corp.** announce the appointment of new representatives for the following territories: **Joseph M. Cantwell**, New Albany, New York; **William H. Dwyer, Jr.**, Indianapolis, Ind. (heating equipment); **Laidlaw Sales Co.**, Indianapolis, Ind. (process equipment); **Industrial Sales Co.**, Columbus, Ohio; **R. R. Walters**, Minneapolis, Minn.; **G. D. Warriner**, state of Michigan; **Clarence Zanin**, Moline, Ill., Davenport, Ia.

The appointment of **John C. Barnes** as vice president for sales, eastern division, is announced by **The Rittling Corp.**, manufacturers of heating equipment, Buffalo, N. Y. Mr. Barnes recently resigned as vice president for sales, National Radiator Co.

Roy O. Nelson who has for the past approximately three years been assistant sales manager of Marsh Heating Equipment Co. of Skokie, Ill., has again joined the **C. H. Bevington Co.**, manufacturers' representative of Chicago.

Taylor Forge & Pipe Works, Chicago, announces the appointment of **Thomas J. Lingle** as western division manager in charge of manufacturing operations at its new Fontana, Calif., plant. He also will direct West Coast sales. Mr. Lingle formerly was associated with C. F. Braun Co. of Alhambra, Calif., engineers, manufacturers and constructors of oil refineries and chemical plants, and since 1946 operated his own valve and fittings business in Alhambra. The Fontana plant of Taylor Forge already has begun production of spiral pipe, and forging operations will begin soon.

Wm. H. Gearhart is the appointed representative for **The Mercoid Corp.**, featuring their full line of automatic controls and mercury switches. Mr. Gearhart's territory includes the state of Michigan, seven counties along the northern border of Indiana and the south side of the city of Chicago.

At the recent general meeting in Hot Springs, Va., **E. A. Bonneville**, sales manager of the room air conditioner division of the **Fedders-Quigan Corp.**, Buffalo, N. Y., was elected chairman of the room air conditioner section of ACRMA.

Appointment of **V. P. Bresan** to the post of general sales manager has been announced by the **Radiator Specialty Co.** of Charlotte, North Carolina, manufacturers and marketers of rubber and chemical specialties for the plumbing and heating trades.

Norbert D. Downey has been appointed assistant sales manager in charge of the central states region of the heating and refrigeration division of the **Fedders-Quigan Corp.**, Buffalo, N. Y. Mr. Downey will cover the area west of Detroit to the mountains and from Canada to the Gulf. Immediate plans call for the opening of a Chicago branch with additional sales engineering personnel to serve the central area.

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B—Apply parting medium to pipes and fill box with Z-Crete insulating concrete.

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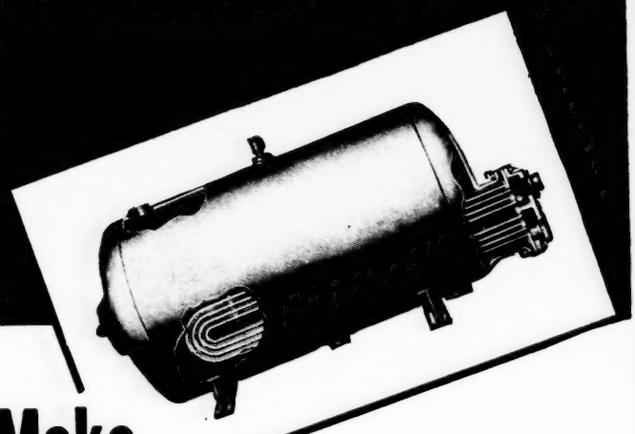

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G. A. Heuser, president of the Henry Vogt Machine Co., Louisville, Ky., has been elected treasurer of **ACRMA.**

The election of **Sidney A. Whitt** as vice president of engineering for **Cordley & Hayes** has been announced. Mr. Whitt has been director of engineering for the water cooler company for the past four years.

Stanley C. Gorman, of Los Angeles, has been appointed sales promotion director of the gas water heater division of the **Gas Appliance Manufacturers Association.**

Midwest Research Institute announces the appointment of **Dr. George E. Ziegler** as director and **Dr. Clayton O. Dohrenwend** as assistant director of the Institute. Dr. Ziegler came to the Institute at the time of its inception in 1945 as executive scientist, having previously been associated with Armour Research Foundation in Chicago. He has been acting chief administrator of the Institute since the resignation of Harold Vagtborg some six months ago. Dr. Dohrenwend has been research consultant since coming to the Institute in July, 1946. He was formerly associated with Illinois Institute of Technology as director of the Mechanics Department.

The American Society of Mechanical Engineers has announced the designation of **Frank S. G. Williams** of New York, eastern manager of **Taylor Forge and Pipe Works,** as chairman of ASA Sectional Committee B-31, which is responsible for the American Standard Code for Pressure Piping.

The Herman Nelson Corp., Moline, Ill., announces the appointment of **John D. Rosebrough** as manager of the company's St. Louis branch office. He will handle sales of unit heaters, unit ventilators, propeller fans, centrifugal fans and unit blowers.

R. S. Purinton has been appointed factory representative covering Ohio, Kentucky, and West Virginia for the **Air-Maze Corp.,** Cleveland, manufacturers of air filters, oil filters, oil separators, silencers, and spark arresters.

Columbia Radiator Co. of McKeesport, Pa., announced the change of its corporate name to Columbia Foundry Co. and its intention to withdraw entirely from the heating boiler and radiator business and devote its entire facilities to the manufacture of production gray iron castings.

B. H. Jennings

Professor Burgess H. Jennings, chairman of the Department of Mechanical Engineering, Northwestern University, was elected president of the **American Society of Refrigerating Engineers** during the 44th annual meeting of the society at the Hotel Statler in Washington, D. C. Professor Jennings, who makes his home in Evanston, has been chairman of the mechanical engineering department at Northwestern since 1940 and previously taught at Lehigh University. During the war he was connected with the Office of Research and Development of the U. S. Government and supervised work on glycol vapor which is now being used in ventilating systems to kill cold germs.

H. Blake Thomas, general sales manager of **McQuay, Inc.,** Minneapolis, was elected chairman of the Lowside Equipment Product Section of REMA at a recent meeting held in French Lick Springs. Mr. Thomas will serve as chairman of the section until April, 1950.

The **Fedders-Quigan Corp.** announces the opening of an office for their Heating Division in the Madison Terminal Building at Clinton and Madison Streets in Chicago. The office will be in charge of **Raymond H. Kelley** and all products of the Heating Division including unit heaters and convectors will be handled.

L. H. Matthes

Louis H. Matthes has been appointed general sales manager of the **General Electric Co.'s** air conditioning department with headquarters at Bloomfield, N. J. As general sales manager, Mr. Matthes will be responsible for field sales activities, commercial engineering, national user sales and for the activities of the customer sales divisions. Mr. Matthes, who was born in Albuquerque, N. Mex., first joined the General Electric Company at Schenectady, N. Y., as test engineer in 1921. In the spring of 1922, he was assigned to the industrial control division at Schenectady as a design engineer. In May, 1924, Mr. Matthes was transferred to the Charleston, W. Va., office of the apparatus department on sales engineering activities, and this was followed in 1928 as manager of the apparatus department's Beaumont, Texas, office. In 1945 Mr. Matthes was transferred to Dallas, Texas, as district manager of the industrial divisions. He served in that capacity until he joined the air conditioning department in October, 1947. Mr. Matthes is a graduate of Texas A. & M. College, where he was awarded the B.S. degree in electrical engineering as a member of the class of 1921. He is a member of the American Institute of Electrical Engineers.

Norton R. Miller has joined **United States Air Conditioning Corp.**, as manager of the company's eastern sales division which includes the New England states, part of New York State and part of Pennsylvania, with headquarters at 420 Lexington Ave., New York City.

Claude M. Lamb has been appointed to the new position of sales manager, Industrial V-Belt Division, and assistant to vice president in charge of mechanical sales of the **Dayton Rubber Co.**, Dayton, Ohio. Mr. Lamb was a field representative for the company's Industrial V-Belt Division in the New England territory from 1938 until 1945, when he was made sales manager of the New York district office. **R. S. Gove** has been named to succeed Mr. Lamb as New York district sales manager.

E. L. Sandberg has been named assistant general manager of the South Wind Division of **Stewart-Warner Corp.**, and **T. M. Redmond** has been appointed plant manager. Both appointments follow by a few days announcement of the appointment of A. R. Collins as head of the Indianapolis division of the company.

Brunner Manufacturing Co., Utica, N. Y., has acquired the controlling interest in the **American Coils Co.**, Newark, N. J., through an exchange in stock. The companies will be operated as separate concerns with American Coils as a subsidiary of Brunner.

Two new sales representatives have been appointed by the **Fitzgibbons Boiler Co., Inc.** of New York, N. Y. In Cleveland, Ohio, the **Thermal Products Company** of 4501 Prospect Avenue, will represent Fitzgibbons, while **A. L. Eubank** has been selected to represent the firm in the Louisville, Ky. area.

At the recent meeting of the **Air Conditioning and Refrigerating Machinery Association** at Hot Springs, Virginia, **Kenneth A. Weatherwax** was elected vice president. Mr. Weatherwax is vice president and general manager of Acme Industries, Inc., of Jackson, Mich.

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